AT 103335

COMMONWEALTH OF KENTUCKY NATURAL RESOURCES & ENVIRONMENTAL PROTECTION CABI DEPARTMENT FOR ENVIRNOMENTAL PROTECTION DIVISION OF WATER



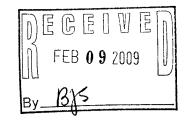
APPLICATION FOR PERMIT TO CONSTRUCT ACROSS OR ALONG A STREAM AND / OR WATER QUALITY CERTIFICATION

Chapter 151 of the Kentucky Revised Statutes requires approval from the Division of Water prior to any construction or other activity in or along a stream that could in any way obstruct flood flows or adversely impact water quality. If the project involves work in a stream, such as bank stabilization, dredging or relocation, you will also need to obtain a 401 Water Quality Certification (WQC) from the Division of Water. This completed form will be forwarded to the Water Quality Branch for WQC processing. The project may not start until all necessary approvals are received from the KDOW. For questions concerning the WQC process, contact the WQC section at 502/564-3410.

and re	project will disturb more than 1 acre of soil, you will also need to complete the attached Notice of Intent for Storm Water Discharges, turn both forms to the Floodplain management Section of the KDOW. This general permit will require you to create which plement an control plan for the project.
1.	OWNER: Boone County Fiscal Court Give name of person(s), company, governmental unit, or other owner of proposed project.
	MAILING ADDRESS: 2950 Washington Street, Burlington, KY 41005
	TELEPHONE #: (859) 572-7588 EMAIL: fennells@nku.edu
2.	AGENT: Northern Kentucky University Center for Applied Ecology (see "Remarks" in Item 18 below) Give name of person(s) submitting application, if other than owner.
	A
	ADDRESS: 510 Johns Hill Road, Highland Heights, KY 41076
	TELEPHONE #: _(859) 572-7588
•	
3.	ENGINEER: Scott Fennell, PE P.E. NUMBER: 18761 Contact Division of Water if waiver can be granted.
	TELEPHONE #: (859) 572-7588 EMAIL: fennells@nku.edu
4.	DESCRIPTION OF CONSTRUCTION: The project includes the restoration and enhancement of 4000 feet of Describe the type and purpose of construction and describe stream impact
	perennial, intermittent, and ephemeral tributaries of Allen Fork. Boone Woods Park is owned and operated by Boone
	County. The property is a 50-acre park with picnic areas, playgrounds and a variety of sports facilities for disc golf, tennis,
	soccor, volleyball, and basketball. The streams that flow through the park are impacted by past and present land use. Stream
	restoration will include sloping the banks, restoring sinuosity, and stabilizing banks and channel bed with rock deflectors and
	a vane. A 12.5-acre riparian buffer will be established. Invasive plants species will be controlled and native species restored
	within the buffer. See attached Stream Restoration Plan for details.
5.	COUNTY: Boone NEAREST COMMUNITY: Burlington, Kentucky
6.	USGS QUAD NAME: Burlington Quad LATITUDE/LONGITUDE: 39°1'37"N, 84°42'29"'W (NAD83)
7.	STREAM NAME: Unnamed tributaries of Allen Fork WATERSHED SIZE (in acres): 690 acres
8.	LINEAR FEET OF STREAM IMPACTED: 1968 feet perennial tributaries of Allen Fork, 2142 feet of intermittent
	tributaries of Allen Fork, and 172feet of ephemeral tributaries of Allen Fork
9.	DIRECTIONS TO SITE: From I-71/I-75: Take Exit 181, KY 18 West; Turn right onto Veterans Way; The project is
	located at Boone Woods Park just past the R.C. Durr YMCA.
10.	IS ANY PORTION OF THE REQUESTED PROJECT NOW COMPLETE? Yes √ No If yes, identify the
	completed portion on the drawings you submit and indicate the date activity was completed. DATE:
11	FSTIMATED REGIN CONSTRUCTION DATE: Summer 2000

Uk pd NKU #314158

COMMONWEALTH OF KENTUCKY ENERGY AND ENVIRONMENT CABINET DEPARTMENT FOR ENVIRONMENTAL PROTECTION DIVISION OF WATER



INDIVIDUAL KENTUCKY WATER QUALITY CERTIFICATION FEE PAYMENT

401 KAR 9:020 Section 401 Water Quality Certification Fees and Certification Timetable

KRS 224.16-050 authorizes the cabinet to certify pursuant to 33 U.S.C. 1341 that applicants for a federal permit regarding the construction or operation of facilities, which may result in a discharge of dredged or fill material into the waters of the Commonwealth, as defined in KRS 224.01-010(33), shall comply with the applicable provisions of the Federal Water Pollution Control Act, 33 U.S.C. 1251 et seq. KRS 224.10-100 authorizes the cabinet to establish a fee for the cost of processing applications for permits authorized under KRS Chapter 224. The project may not start until all necessary fees are paid and approvals are received from KDOW. For questions concerning the WQC process, contact the WQC Section at 502-564-3410. For more information: http://www.water.ky.gov/permitting/wqcert/

1.	OWNER: Boone County Fiscal Court Provide name of person(s), company, governmental unit or other owner of proposed project.										
	-	950 Washington		0 ,	. or proposed projects						
	Burlington, Kentucky 41005										
	TELEPHONE #: (859) 334-22	-		jearly	wine@BooneCountyKy.org						
	AGENCY INTEREST (AI) # OF		_								
2.	AGENT: Scott Fennell, PE		ter for Applied E								
	Provide name of person(s) submitting application, if other than owner.										
	ADDRESS: 510 Johns Hill R	oad									
	Highland Height	ts, KY 41076									
	TELEPHONE #: (859)572-7595		E-MAIL:	fennells	@nku.edu						
stream res tributaries 1968 linea linear feet	toration at the Boone Woods Park in Boone of Allen Fork run through the park and join ar feet. The other stream (South Branch) is in	County. The park is just as they leave the itermittent and is 1050 to property totaling 17	owned by Boone Couproperty. Two of the D linear feet. A secon 71 linear feet. The str	unty and is lose streams (Nd intermitten reams feed the	he Center for Applied Ecology proposes to conduct cated on Veterans Way near KY Highway 18. Three Jorth Branch, Central Branch) are perennial and total t stream is a tributary to the Central Branch and is 1092 e North Branch and the Central Branch. For a detailed						
4.	COUNTY: Boone				Burlington, KY						
5.	STREAM NAME(S): Unnamed T										
	(Start and end points of each individual impact; add more sheets if necessary.)										
	Stream sections		t Latitude/Long		End Point Latitude/Longitude						
	North Branch				84°42' 35.25" W /39° 1' 38.8" N						
	Central Branch		W /39° 1' 34.22"		84°42' 35.37" W /39° 1' 38.29" N						
	South Branch	84°42' 34.31"	W /39° 1' 27.62"	N	84°42' 35.47" W /39° 1' 36.04" N						
7. 8.	EXEMPTED FROM FEE BECA (A) {Personal Residence	USE:		_	ion:						
9.	FEES:										
Stream Stream	impact greater than 500 linear fee impact 1,000 linear feet to 5,000 li impact greater than 5,000 linear to d impacts	inear feet:	1,000 linear feet:	Fee - \$? Fee - \$, Fee \$50	1,000.00						
SIGNA'	To the best of my knowledge, at the TURE:	Q1, -		DATI	E: JAJUARY 20, 2009						
~IGIM	Owner or Agent sign here. (If sig	ned by Agent, attac	h Power of Attorney	DA11 /.)							
EFFA	ET S. EHLTMAIL	Make check to:	KY STATE TR	EASURE	R						
COLUNT	7 MANUS MARM		MAIL TO:								

Kentucky Division of Water Water Quality Certification Section 200 Fair Oaks Lane Frankfort, KY 40601

Stream Restoration Plan

Boone Woods Park Boone County, Kentucky

November 2008

BACKGROUND

Stream and riparian buffer restoration and preservation is being conducted at Boone Woods Park as compensation for unavoidable stream impacts by other parties and at other sites as required by Section 404 and/or Section 401 permits issued to the other parties. Restoration is being funded by the Northern Kentucky Stream and Wetland Restoration Fund, under the direction of the Inter-agency Review Team (IRT). The IRT is chaired by the Louisville District Corps of Engineers and includes Kentucky Division of Water, Kentucky Department of Fish & Wildlife Resources (KDFWR), US Fish and Wildlife Service, and US Environmental Protection Agency. The restoration is being conducted by the Center for Applied Ecology at Northern Kentucky University (CAE).

This Plan is being submitted by the CAE in order to obtain final project and funding approval from the IRT, and to support permit applications (Section 401 and 404, grading permits, etc). The format and information provided is generally as stipulated in the Compensatory Mitigation Rule (33 CFR 332.4(c))

ENGINEER'S CERTIFICATION

Electronic or photocopy versions of this document without a licensed professional engineer's original or electronic stamp, date, and signature affixed, are required to have the following notice: "This shall not be considered a certified document." Paper versions of this document are considered certified if the engineer's original stamp, date, and signature are affixed.



OBJECTIVES OF RESTORATION

The objectives of this project are to restore and protect streams, floodplains, and riparian buffers at the project site which provide the following functions and values:

- 1. Aquatic and wildlife habitat stream shading and organic debris inputs; reproduction and refuge; substrate, cover, food production; etc.
- 2. Water quality protection nutrient, pathogen, and sediment removal; floodwater management; aeration; groundwater and baseflow recharge; etc.
- 3. Nature viewing, passive recreation, and education opportunities in a publicly accessible natural area.

Specific restoration tasks are designed to be self-sustaining and include natural stream channel restoration; bank stabilization; removal of stream and floodplain obstructions; stormwater wetland creation; and riparian forest and meadow enhancement and restoration.

SITE SELECTION

This project provides mitigation for prior stream losses within the Middle Ohio HUC 8 Watershed, restoring and protecting values and functions of headwater streams. Additionally, the project site was identified as the highest priority restoration site in a watershed plan prepared by Bio-Habitats, Inc. (et. al.) for Boone County government (Allen Fork Headwater Feasibility Study, 2005). Allen Fork is a 303(d) Listed Impaired Water based upon sediment/siltation and nutrient pollution.

SITE PROTECTION INSTRUMENT

Boone County executed a memorandum of agreement (18 December 2007) to file a conservation easement permanently protecting the streams and riparian buffers upon approval of this plan. The conservation easement holder will be the Northern Kentucky University Research Foundation.

BASELINE INFORMATION

Site Address: Boone Woods Park, 6000 Veterans Way, Burlington, Kentucky

Lat / Long: 39.0133°N, 84.4236°W (NAD27)

Maps (Appendix A):

- Figure 1 Location and Directions
- Figure 2 USGS 7.5-Minute Topo Map with Watersheds
- Figure 3 Aerial Photo

- Figure 4 NRCS Soils Map
- Figure 5 Project Task Locations
- Figure 6 North Branch Stream Restoration (Task 1)
- Figure 7 Conservation Area Restoration and Preservation (Task 4)

Site Landuse: Boone Woods Park is owned and operated by Boone County. The property is a 50-acre park with picnic areas, playgrounds and a variety of sports facilities for disc golf, tennis, soccer, volleyball, and basketball. An aerial photograph of the property is provided in Figure 3, Appendix A. The property is approximately 30 percent forested.

Streams: The streams to be enhanced or restored include approximately 4000 feet of perennial and intermittent tributaries of Allen Fork (Figure 5, Appendix A), as well as mapped and unmapped ephemeral tributaries within the conservation area.

Watershed Landuse: The 690-acre watershed that drains to the project reach is primarily residential and commercial development, roads, recreation land, and undeveloped land.

Wetlands: No jurisdictional wetlands are within the project boundaries.

Riparian Buffer: The total area of protected streams and riparian buffer is 12.5 acres. The average riparian buffer width is about 50 feet, which is to be restored to native vegetation.

Water Quality: No water quality data is known to be available for the project stream reaches. However, Allen Fork is a 303(d) Listed Impaired Water, with identified impairments such as sediment and nutrients attributed to habitat modification and urban stormwater.

Aquatic Community: No aquatic community data is known to be available for the project stream reaches, although the project's upper headwater streams (watershed < 1 square mile) are expected to provide habitat primarily for macroinvertebrates and amphibians, rather than fish. Completed habitat assessment forms for the major stream reaches are provided in Appendix B. The habitat assessment protocols were developed for larger streams and address fish habitat values, so scoring parameters have been modified to reflect natural conditions and values of upper headwater streams.

T/E Species: No threatened or endangered species are known to occur on the site or in the vicinity. As requested by USFWS (letter 6 June 2008), prior to disturbance the project limits will be surveyed for Running buffalo clover during the growing season, and potential Indiana bat roosting snags and trees.

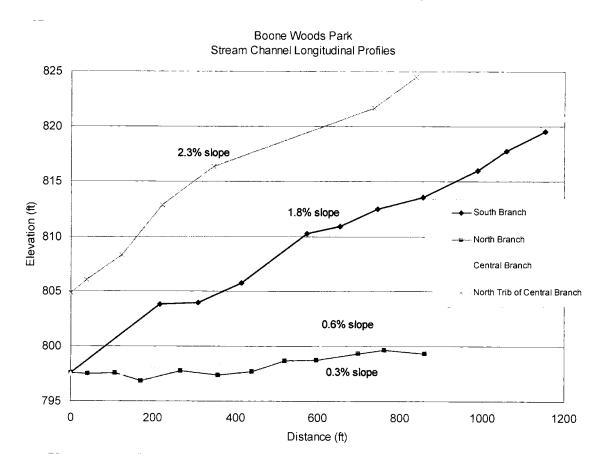
Cultural Resources: No significant cultural resources are known to occur on the site or in the vicinity. Based upon a project review by Kentucky Heritage Council no survey is necessary (letter 30 April 2008).

Technical Contact: Scott Fennell, PE, Center for Applied Ecology. 859-572-7588

Owner Contact: David Whitehouse, Director of Boone County Parks. 859-334-2117

WORK PLAN

In the following sections, descriptions of current conditions and restoration plans are provided. In addition, the locations of the four subject streams are illustrated on Figure 5, current stream conditions are scored in Appendix B, and longitudinal profiles are provided below.



Note that details of erosion control and riparian re-vegetation are described in Appendices C and D, not within the restoration task descriptions below. Excess soil generated from stream restoration will be placed on-site, mostly outside the riparian buffer, at upland locations to be agreed with the Parks Director.

<u>Task 1 – North Branch Stream Restoration</u>

Current Conditions – The North Branch drains a 372-acre watershed of primarily residential and undeveloped land (Figure 2). Compared to most northern Kentucky streams of similar watershed size, the channel slope is flat (0.3 percent) and the stream has a flat floodplain, now disconnected from the stream. The stream channel was historically straightened (1.04 sinuosity) and exhibits past downcutting and current widening (Rosgen G4/5; Channel Evolution Model Phase III). The floodprone width (2 X bankfull max depth) is within the 3-foot deep incised channel, and the steep banks lack significant riparian vegetation. The channel width at the top of

banks is 10 to 11 feet. The streambed is comprised primarily of sand or gravel with scattered flagstones, and the banks are primarily silt over clay. The depth to bedrock beneath the streambed varies from a few inches upstream to 2.5 feet downstream.





North Branch facing downstream. Stream condition at right (dry) due to extended drought.

Restoration Plan – The North Branch is to be restored to a Rosgen Type C/E 4/5 meandering stream using a Priority 2 approach—maintaining the current channel elevation and excavating the banks to create a connected floodplain. Key parameters from a stable reference reach in an adjacent watershed, comparable in size and landuse, are:

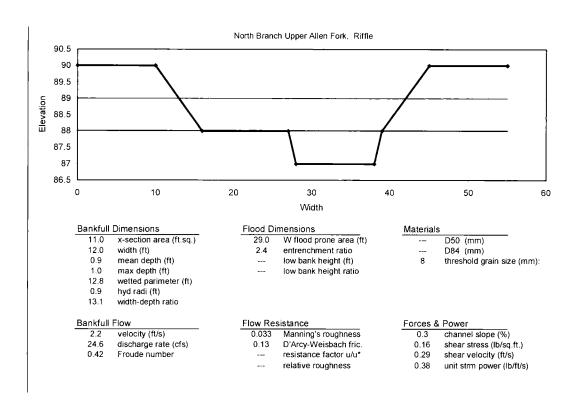
- Bankfull width 11 feet
- Mean depth 18 inches
- Sinuosity 1.26
- Channel slope 0.8 percent



Reference Reach facing downstream.

In order to increase the sinuosity of the stream, the stream length will be increased from 770 to 840 feet, relocating sections of the channel into the former floodplain to the extent practical, to achieve an increased sinuosity of 1.14 (Figure 6). The bankfull width of the restored channel will be 12 feet, with the floodplain elevation one foot above the streambed. The floodplain width will be 11 feet, with sideslopes above the floodplain sloped at 3:1, creating an entrenchment ratio of 2.4 (see cross section below).

• Bed materials - sand and gravel with some small flagstones, some exposed bedrock.



Cross section and hydraulic calculations utilize Ohio DNR Reference Reach Survey 4-3 L.xls

Since the restored channel is somewhat wider and shallower than the reference reach, it is anticipated that sediment will drop out in the floodplain and narrow the channel (natural channel evolution from Rosgen C to E), which will reduce sediment in the stream and improve the soil quality of the floodplain, promoting improved vegetation. It will have the additional benefit of reducing the sediment load to the lake on the downstream property. Imported stone will not be placed in the riffles / crossovers or outside bends, unless determined to be necessary as a retrofit during the monitoring phase. Pools will be excavated on the outside of meander bends 18 inches below the riffle / crossover elevation (or to



Example Rosgen C3 Restoration at Florence Golf Course. Imported stone will not be used at Boone Woods unless necessary.

bedrock if shallower), consistent with naturally occurring pool depths in upper headwater streams.

An ephemeral tributary to the North Branch is culvertized until it outlets at the park boundary. The watershed of the culvert is approximately 8 acres of residential land, and the on-property channel is approximately 100 feet of riprap, gully, and fescue swale. In

order to improve water quality, provide additional

habitat diversity, and recharge baseflow, the channel will be reconstructed and diverted to a stormwater wetland constructed within the former floodplain, ranging in depth from zero to 24 inches deep. The model for the construction will be a similar stormwater wetland constructed for the Bentwood Hills project, which has been demonstrated to provide good amphibian and reptile habitat.

Additional tasks such as the removal of stream and floodplain obstructions, the relocation of



Example small stormwater wetland at Bentwood Hills.

the disc golf course, and riparian re-vegetation are addressed under Task 4.

<u>Task 2 – Central Branch Bank and Channel Stabilization</u>

Current Conditions – The Central Branch drains 280 acres of residential, recreational, and commercial land (Figure 2), and was historically straightened and moved to the edge of the valley to maximize past agricultural landuse. The 0.6 percent channel is recovering some sinuosity, but is undercutting approximately 660 feet of left descending bank. The right descending floodplain is mowed and utilized for picnicking and outdoor fairs, in some places within 25 feet of the bank.





Undercutting left descending bank at Boone Woods. Boulder deflectors at Adair WMA.

An intermittent tributary discharges to the Central Branch from the north. The upper 500 feet of the 2.3 percent tributary stream is forested, while the lower 500 feet flows through turf grass. The disc golf course crosses or encroaches on the channel at several locations, and 120 feet is culvertized just above the confluence.

Restoration Plan – In order to reduce sediment in the stream and protect the riparian forest

buffer, the left descending bank will be stabilized using boulder deflectors to divert flow away from the toe of slope. In addition to protecting against continued undercutting, it is likely that sediment will accumulate upstream of each deflector, and scour pools will develop downstream of the deflectors, improving bank vegetation and aquatic habitat. Deflector sites will be determined in the field based upon the location of trees, stream flow direction, etc. but are anticipated to be spaced no closer than one bankfull width apart (13 feet) on average. To prevent flanking, the top of the deflectors will extend above the bankfull elevation, and the ends will be keyed into the banks to the extent practicable, while preserving trees, etc.



Downstream view of Central Br Trib.

Near the upstream end of the Central Branch, a sanitary sewer aerial crossing and bridge have been stabilized with grout on a 25 ft length of stream channel. The grout is being flanked and undercut, and will be removed. In place of the grout, the channel bed will be stabilized using a boulder cross vane (see below). The invert of the vane will be in the approximate center of the channel to direct and concentrate flow, and the bank ends will extend to at least bankfull elevation plus six inches to protect against flanking. Similar to the boulder deflectors, sediment deposition is expected on the upstream banks, and a scour pool is expected to form downstream, improving bank vegetation and aquatic habitat diversity.





Failing grout in the channel at Boone Woods. Boulder cross vane at Woodland Hills.

Miscellaneous subtasks for the Central Branch will be removing grouted riprap from two locations on the right bank, excavating two point bars to reduce outside bend stress, 3:1 sloping of 75 feet of 4-foot vertical bank, and repairing 60 feet of ephemeral tributary that drains over the steep left bank as a gully.

Tasks such as the removal of additional stream and floodplain obstructions, the relocation of the

electric service and grills, relocation of the disc golf course, and riparian re-vegetation are addressed under Task 4.

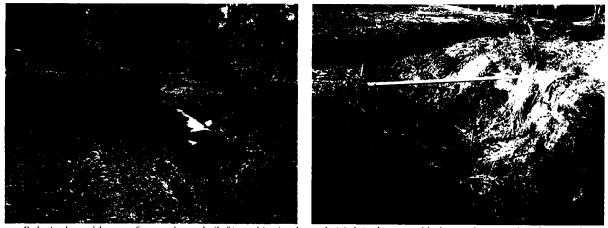
Task 3 – South Branch Restoration

Current Conditions – The South Branch drains a 38-acre watershed of residential and recreational land and has a slope of 1.8 percent. The upper half of the on-property reach is forested, and approximately 500 feet of the forested reach exhibits past downcutting and current widening (Rosgen G3/4; Channel Evolution Model Phase III). The channel bed is mostly gravel and small flagstones.



Relatively stable forested reach (left) and incised forested reach (right) on South Branch.

The lower half of the South Branch runs through turf grasses, and the channel bed is comprised of approximately 3 feet of fine sediments (clay silt) over bedrock. A 30-inch culvert is providing grade control. Upstream of the culvert, approximately 140 feet of stream is a relatively stable Rosgen E6 channel. Below the culvert, approximately 200 feet of stream exhibits downcutting and widening (Rosgen G6; Channel Evolution Model Phase II / III) until entering another Rosgen E6 reach. Measured from the top of banks, the incised channel width is about 7 feet, and the depth is about 3 feet, so that the floodprone width is within the incised channel.



Relatively stable non-forested reach (left) and incised reach (right) above and below culvert on South Branch.

Restoration Plan – The approximately 700 feet of incised reach will be restored to a Rosgen B3/4c (<2% slope) channel using a Priority 2 approach—maintaining the existing channel elevation. Based upon regional reference reaches and the stable upstream reach, the bankfull width should be 10 to 12 feet at a mean depth of about 1 foot. To the extent practical, the incised reaches will be widened to the reference width, and either a bankfull bench constructed, or the floodprone width maximized, while preserving desirable trees and creating flatter slopes (3:1) to facilitate revegetation (i.e., the desired bankfull width may not be achievable in the



Incised / sediment-filled channel restored to Rosgen A/B channel with floodprone width at Adair WMA.

entire reach). Additionally, in the lower non-forested section, oversize gravel (or flagstone, if available) will be placed in the streambed to prevent continued downcutting, and to enhance habitat value. The 30-inch culvert will be removed and replaced with a stone ford at the same invert elevation, to facilitate mowing vehicle access across the channel, and to provide continued grade control.

Task 4 – Conservation Area Restoration and Preservation

Current Conditions – As previously described, the riparian zone and streams are highly

impacted by uses such as the disc golf course, picnicking, occasional fairs, etc. For example, disc golfers are frequently on the banks and in the stream channels recovering discs. Various stream and floodplain obstructions include footbridges, culverts, disc golf tees and nets, electric service, etc.

Approximately half of the proposed riparian buffer is vegetated with turf grasses mowed to the top of the banks. Approximately half the riparian buffer is forested, varying from high quality forest (low invasives; larger crown trees) to low quality (high invasives, young trees).



Foot bridge and undermined abutment to be removed. Stone to be re-used in the channel.

Restoration Plan – A 12.5-acre riparian buffer will be established along the length of the subject streams averaging about 50 feet from each bank. Along portions of the Central and South Branches, the riparian buffer will be as narrow as 25 feet due to the close proximity of park features such as electric service, grills, picnic tables, and a shelter.

The following obstructions will be removed from the streams or riparian buffer: old pasture fence and posts, stone stairs, 5 of 8 timber foot bridges, and 2 culverts. The following obstructions/impairments will be relocated outside the riparian buffer: 4 electric service boxes and 2 charcoal grills to at least 25 feet from the streams, and 13 (+/-) disc golf tees or baskets to at least 50 feet from the streams. In consultation with the Parks Department, the entire disc golf course will be reconfigured to minimize in-play zones within or crossing the riparian buffer and streams.

Turf grasses in the non-forested areas of the riparian zone will be eradicated and replaced with native grasses, wildflowers, shrubs, and trees. Existing forests will be enhanced by removing invasive woody vegetation such as bush honeysuckle and multiflora rose, and turfgrasses where present. Supplemental shrubs and trees will be planted in forested areas where natives are scarce. In areas where the disc golf course crosses the riparian buffer, the in-play areas may be maintained as native meadow by periodic mowing (e.g., annually in the fall). The re-vegetation plan is detailed in Appendix D.



 The riparian buffer perimeter will be surveyed and posted at 150- to 200-foot



Culvert replaced by stone ford at Adair WMA.



Example native meadow plantings at Woodland Hills.



Natural area boundary marker.



Interpretive sign (2' x 3').

intervals, including a no-mowing label (except where managed as native meadow).

- An interpretive natural area sign will be installed at a conspicuous location.
- Access control fencing (e.g., spit rail fence) will be installed along reaches of the stream particularly vulnerable to damage from frequent visitor access.

Permitting – Permits, sign-offs, and/or notices believed to be applicable to this project are tabulated below (indicated by $\sqrt{ }$). Agencies will be contacted to verify permitting requirements:

Issue	Permit / Notice	Agency
 Filling of Waters of US	CWA Sec 404 NWP 27	Corps of Engineers
 Water Quality	CWA Sec 401 Water Quality Cert.	KY Div of Water
 Stormwater Mgmt	Land Disturbance Permit if > 1 acre	Sanitation District 1
 Stormwater Mgmt	48-Hour Notice of Intent if > 1 acre	KPDES Branch
 Floodplains	Stream Construction Permit (SCP) *	KY Water Resources Branch
 Floodplains	SCP Application Review & Sign-off	Local Floodplain Coord.
 Grading	Grading Permit	Boone County
 T&E Species - plants	Notice	KSNPC & USFWS
 T&E Species - wildlife	Notice	KDFWR & USFWS
 Cultural Resources	NHPA Sec 106 Review	Kentucky Heritage Council

^{* -} Public notice in local newspaper may be required concurrent with permit application.

PERFORMANCE STANDARDS

Performance Standards for each restoration task are summarized below. Note that the Watershed Watch Habitat Assessment (equivalent to USEPA RBP) was developed for fish habitat potential in larger headwater streams (e.g., watershed area 3-5 sq mi) and has been modified to reflect the different habitat potential of steeper (> 2%) and/or smaller watershed (< one sq mi) streams, which are primarily habitat for macroinvertebrates, reptiles and amphibians rather than fish. For example, a riffle/pool pattern does not generally occur in channels steeper than two percent slope, velocity/depth regimes such as deep/fast do not naturally occur in small channels, and epifaunal substrate may be naturally scarce in small silt-bed Rosgen E channels.

	Task	Geomorphology	Habitat	Vegetation					
1	North Branch	Stable channel	KDOW Watershed Watch Habitat						
2	Central Branch and Tributary	banks & bed based upon visual	AssessmentModified scoring for steep-gradient (>2%) or upper-	See Task 4					
3	South Branch	assessment at least annually.	headwater streams (< one sq mi watershed). Pre-Construction (see Appendix B) then Years 1, 3 & 5.	Sec Task 4					
4	Conservation Area Restoration and Preservation	600 native stems/acre (incl volunteers); < 5% woody non-native invasives. Report species list, wetland indicator status, and relative abundance of native woody plants Years 1, 3 & 5.							

DETERMINATION OF CREDITS

The following table provides an estimate of the adjusted mitigation units (credits) to be generated by the project, based upon a scoring system developed by the Louisville District Corps of Engineers. Scoring will be finalized at the end of the 5-year maintenance and monitoring phase based upon actual before and after project conditions.

Impacts

Water Body	Туре	Quality		Impact Type	Linear Ft	Area (acres)	Ratio	Final Adjusted Areal Impacts	Final Adjusted Linear Impacts
North Branch -				fill for new					
RPW	Per	Poor		channel creation	330	0.083	1.50		495.0
North Branch				fill for new		, i			
Trib	Eph	Poor		channel creation	50	0.013	0.50		25.0
Total					380	0.096			520.0

Mitigation

		T								Finai	Finai
Water Body	Туре	Initial Quality	Initial Ratio	Final Quality	Final Ratio	Mitigation Type	Area	Linear Ft	Mit. Ratio	Adjusted Areal Mitigation Units	Adjusted Linear Mitigation Units
North Branch - RPW	Per	0	0.00	Exc	3.00	New channel w/50 ft buffer each side		70	1.00		210.0
North Branch - RPW	Per	Poor	1.50	Exc	3.00	Priority 2 restoration with floodplain creation, obstruction removal, and 50 ft buffer each side		770	1.00		1155.0
North Branch Trib	Eph	Poor	0.50	Exc	1.00	Stream relocation, diversion to stormwater wetland w 50 ft buffer ea side		100	1.00		50.0
North Branch Trib stormwater wetland						Wetland creation by excavation	0.10		0.50	0.1	
Central Branch -	Per	Poor	1.50	Exc	3.00	Bank and channel stabilization and obstruction removal, w 50 ft buffer left side, 25 ft buffer right side		1000	0.70		1050.0
Central Branch Eph Trib	Eph	Poor	0.50	Exc	1.00	Channel reconstruction w 50 ft buffer ea side		60	0.70		21.0
Central Branch Int Trib	Int			Exc	2.00	50 + ft buffer enhancement w inv species removal, disc golf relocation, and native plantings		900	0.22		396.0
South Branch	Int	Poor	1.00	Exc	2.00	Priority 2 restoration with floodprone width creation, obstruction removal, and 50 ft buffer each side		700	1.00		700.0
South Branch	Int			Exc	2.00	50 + ft buffer enhancement w inv species removal, disc golf relocation, and native plantings		336	0.22		147.8
TOTAL								3,936		0.1	3,729.8

Net Mitigation - Adjusted Mitigation Units:

3,210

MAINTENANCE & MONITORING PLAN

All projects implemented by the Center for Applied Ecology entail project observation and direction by the restoration design professionals during construction, including observation and direction for all critical activities.

Approximately one year after substantial completion of stream restoration activities, an As-Built Report and First Year Monitoring Report will be submitted. (Completion of riparian revegetation may not be completed until the following year.) Deviations from the approved Plan will be documented in the As-Built.

Project maintenance and monitoring will be conducted by the Center for Applied Ecology at least annually for five years after substantial completion of stream restoration. During the maintenance & monitoring period, minor maintenance is anticipated for such things as localized bank erosion and control of invasive vegetation to ensure the project achieves the Performance Standards outlined above. Monitoring results, minor maintenance, and any Corps-approved corrective actions (see Adaptive Management Plan below) will be documented using maps, photos, tables, and graphs.

Monitoring reports will be submitted biannually (Year 1, Year 3, and Year 5) to maximize project cost-effectiveness.

LONG-TERM MANAGEMENT PLAN

The project is designed to be self-sustaining and no long-term management is anticipated other than site protection. After the five-year maintenance and monitoring phase, the easement holder will conduct occasional inspections of the conservation area to ensure the terms of the easement are maintained, and will replace broken or missing boundary signs as necessary. Conservation easement management funding is discussed under Financial Assurance.

ADAPTIVE MANAGEMENT PLAN

The project is to be constructed, managed, and monitored by the Center for Applied Ecology.

During construction, opportunities will be considered to improve project results or achieve cost savings. These may include construction adjustments to save desirable trees and other vegetation, utilizing alternative sources of stone, minor changes to incorporate innovative or demonstration techniques and materials, etc. Projects adjustments may also be required to address unforeseen circumstances, such as the discovery of refuse/waste or cultural resources, or additional restoration opportunities.

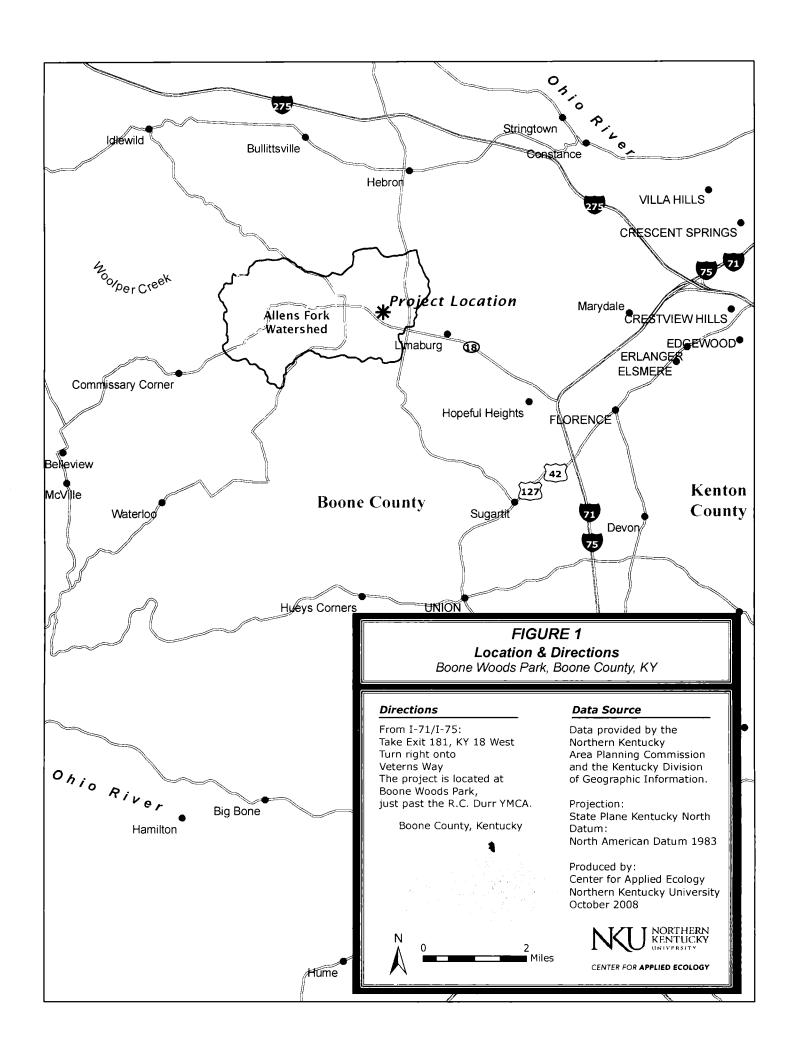
If monitoring results indicate a significant failure to meet Performance Standards (i.e., beyond anticipated minor maintenance), the Corps of Engineers will be consulted as to whether

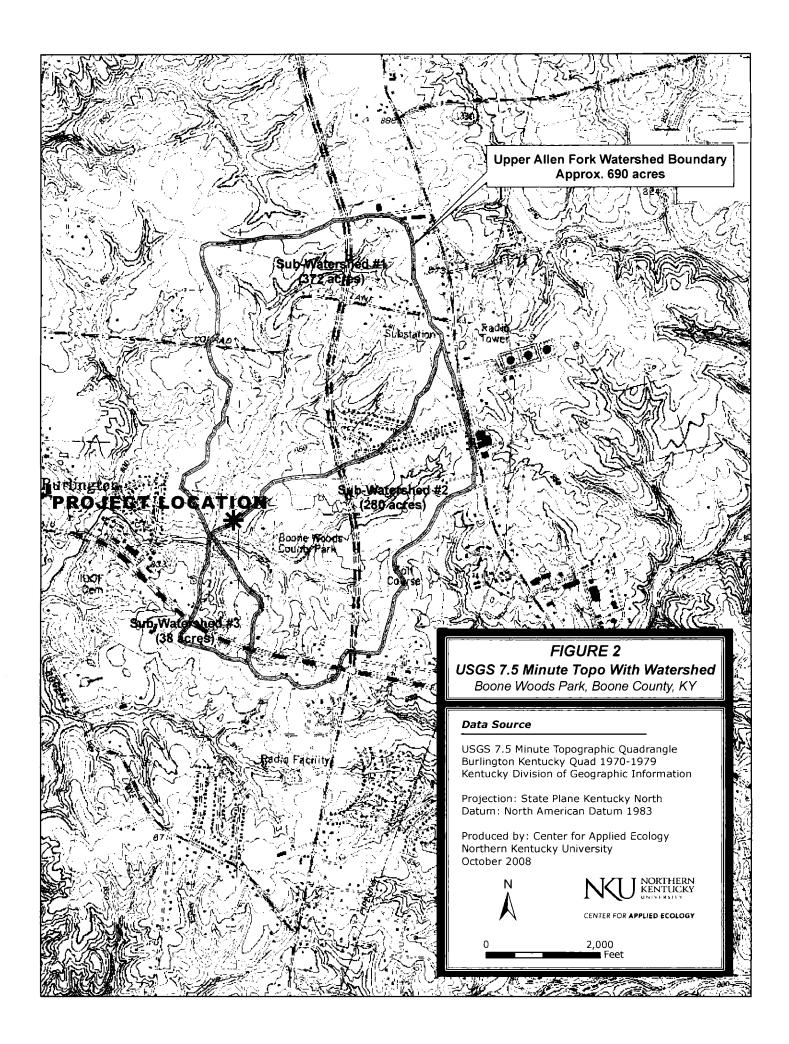
corrective action is required, and if so, they will be implemented as expeditiously as practicable. Alternatively, project credits may be adjusted to reflect a lower credit value if standards are not practically and cost-effectively achievable, or the period of maintenance & monitoring may be extended beyond five years until standards are achieved.

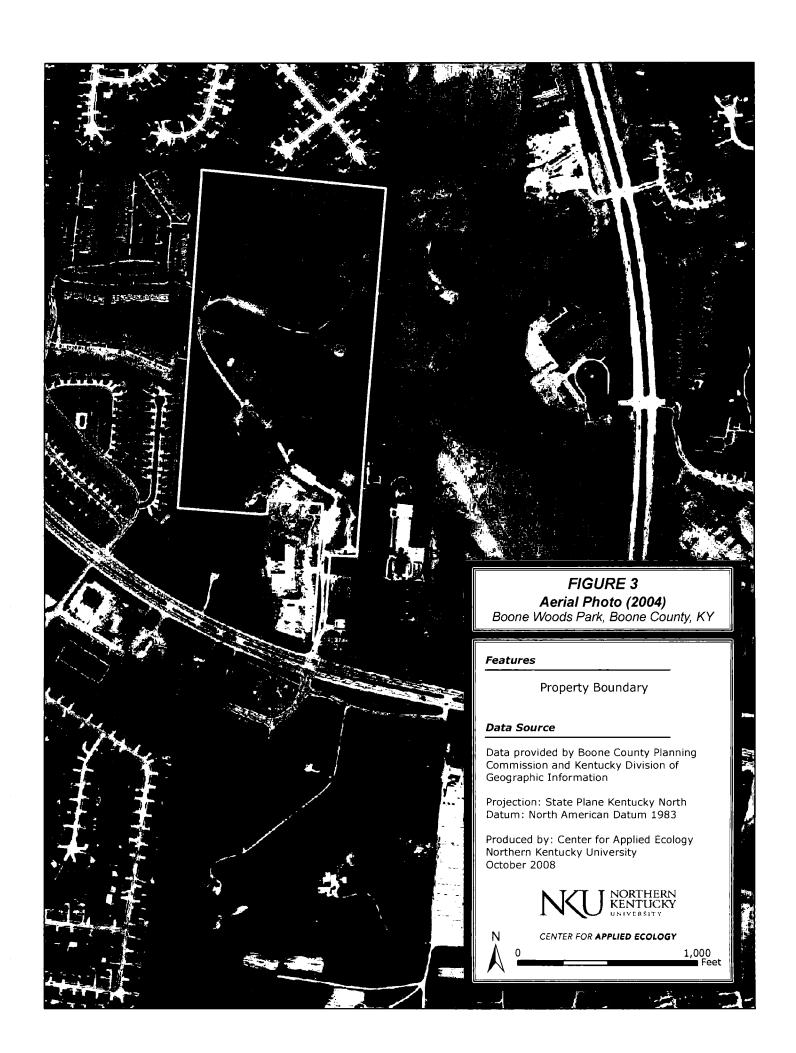
FINANCIAL ASSURANCE

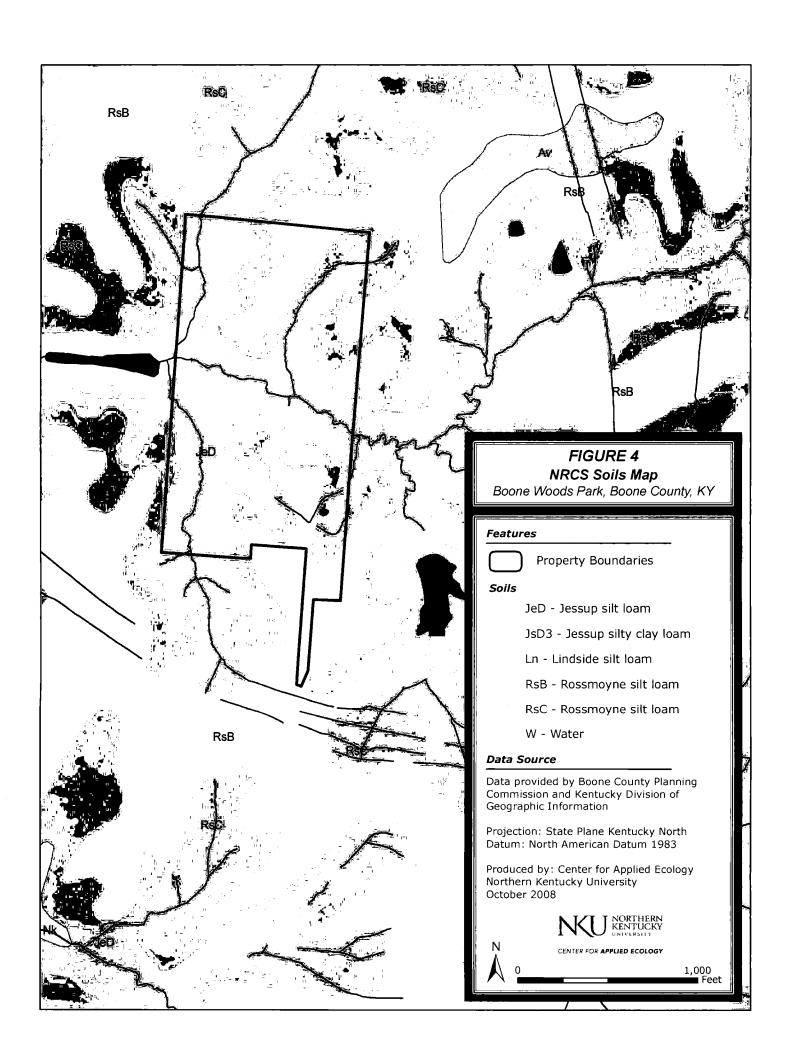
Project funding is to be approved by the IRT and is currently available and earmarked within the Northern Kentucky Stream & Wetland Restoration Fund (NKSWRF). The project budget includes a contingency / reserve fund and a five-year maintenance and monitoring budget. Additionally, a non-wasting endowment has been established to fund perpetual conservation easement monitoring to ensure the project area remains a natural area. The Conservation Easement Fund (CEF) is managed by the easement holder, the Northern Kentucky University Research Foundation (NKURF). Both the NKSWRF and CEF are subject to annual auditing and reporting to the Louisville District Corps of Engineers.

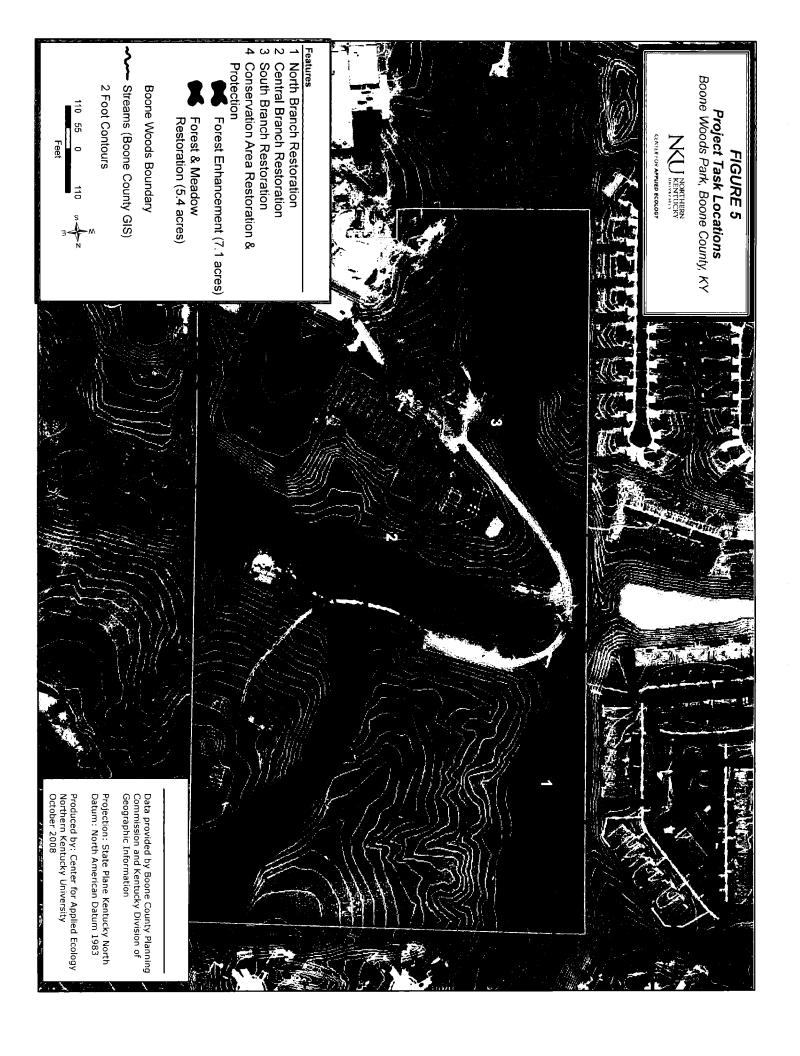
APPENDIX A – FIGURES

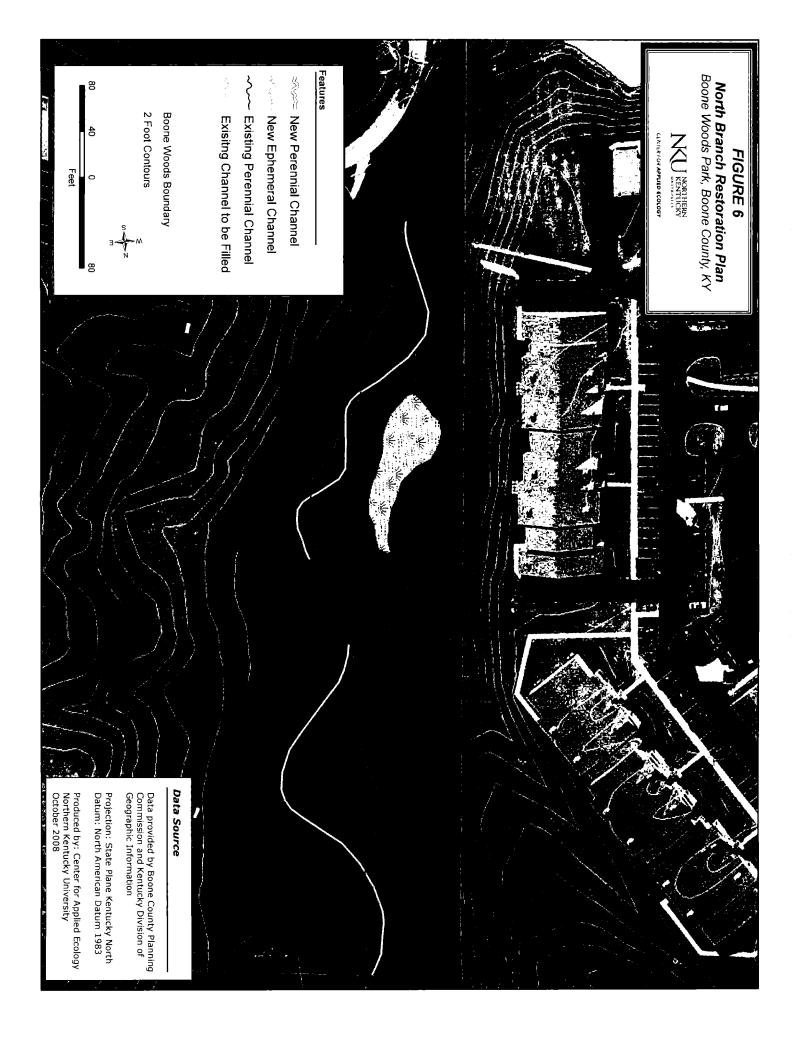














APPENDIX B – HABITAT ASSESSMENT FORMS (Modified Scoring for Upper Headwater Streams)

NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

	(0.20.20.00.00.00.00.00.00.00.00.00.00.00							
STREAM NAME:	Allen Fork 2	Vorth Brans	4 LO	CATION:	North	Branch		
STATION #: '5	MILE:	,		SIN/WATE				
LAT.:	LONG.:			UNTY: B		USGS 7.5 TO		
DATE: 11/13/0	8 TIME: S		INV	ESTIGAT	ORS: Cry	istal C., O	iannea	W. JOHNHALL
TYPE SAMPLE:	□P-CHEM □Macroinverte	brate FISH	BACT.	Ma		,		
☐ Stream restora	tion, completion date	·						
WEATHER:	Now Past 24 hours				y rain in th	e last 7 days?	_	
. 14	☐ ☐ Heavy rain		Yes [20	
() out	☐ ☐ ☐ Steady rain ☐ ☐ ☐ ☐ Intermittent show			ature loud Cover		rainfall in past	24 hours	in.
` `	Clear/sunny	reis <u>7</u>	5_70 C	ioua Cover				
P-Chem: Temp (°C		% Saturation	pH (S.U	(J)	Cond.	Grab		
INSTREAM WA		LOCAL WATERS						·····
FEATURES:		Predominant Surrou						
Stream Width (riff		Surface Mining		Constr			est/Silvicult	
Range of Pool Dep		Lawn		⊠ Comm			ture/Grazing	3
Average Velocity	 ft/s	Park		Industr		□Hay		
Est. Reach Length	on entire restoration reach; not	☐Land Disposal / I	umps	□Row C	rops	D Urt	an Kunoii/S	Storm Sewers
limited to 100 m se		•						•
Hydraulic Structur	es:	Stream Flow:			1	Stream	n Type:	
☐Dams	Bridge Abutments	☐Dry ☐Pooled			Normal	Per		Intermittent
☐Island	■Waterfalls	☐High ☐Very R	apid or 1	Forrential	,	□Epl	nemeral 🔲	Seep
Other			•		T			
Riparian Vegetatio Dominate Type	n: Dom. Tree/Shrub Ta		:	50 /\		Alterations:	Riffle-riff	
☐Trees	☐ Shrubs	Fully Expos	nosed (2	270) 25-50%)	Dredg	nelization		annel type
Grasses	Herbaceous	Partially Sh	aded (5))-75%)		Partial)	Chainer	Wol. Model
Number of strata		☐Fully Shade			[]			
Stream Quality	Good (G) Fair (F)	Poor (P)			Score	Possible Pts	%	Condition (G, F, P)
Rosgen C	>155 142-155	<142	Forme					
Other	>77.5% 71-77.5%	<71%	Existi		94	160	59	Ρ
			Futur	e**				
NOTE: Rosgen C	(<2% slope) based on scoring o	f all 10 parameters	**Esti	mated futu	re score bas	sed on the follow	ving: 🔲 In-S	Stream Habitat,
	nay exclude #2, 3, and 7 below; below; other exclusions on a site		LINC	D Stream F	Restoration,	Bank Stabil	zation, LIF	uture
Habitat	elow, outer exclusions on a site	specific basis.		ition Cate	Vegetation	, L JOUNET	14	
Parameter	Optimal	Suboptimal	Conu		gory [arginal	<u> </u>	Poor	Comment
1. Epifaunal	Greater than 70% of substrate	40-70% mix of stable	habitat;		mix of stable		20% stable	Comment
Substrate/	favorable for epifaunal	well-suited for full		habitat; h			ck of habitat	
Available Cover	colonization and fish cover;	colonization potential;		1	ity less than		; substrate	
	mix of snags, submerged logs, undercut banks, cobble	adequate habitat for maintenance of popula	ations.		; substrate y disturbed	unstable o	r lacking.	
l ,	or other stable habitat and at	presence of additional		removed.	•	· .	•	
	stage to allow full	substrate in the form of						
	colonization potential (i.e.,	newfall, but not yet pr	-					
	logs/snags that are <u>not</u> new fall and <u>not</u> transient).	for colonization (may high end of scale).	rate at					
SCORE	20 19 18 17 16	15 14 13 12	11:	10 9	8 (7) 6	5 4	3 2 1	0
2. Embeddedness	Gravel, cobble, and boulder	Gravel, cobble, and bo			obble, and	Gravel, co		
	particles are 0-25%	particles are 25-50%			particles are		articles are	
	surrounded by fine sediment. Layering of cobble provides	surrounded by fine sec	iment.	75% surre	ounded by f	ine more than surrounde		
	diversity of niche space.			Scannent.	•	sediment.	d by line	
SCORE	20 19 18 17 (16)	15 14 13 12	11	10 9	8 7 .6		3 2 1	0
3. Velocity/Depth	All four velocity/depth	Only 3 of the 4 regime			f the 4 habit	at Dominate	d by 1	
Regime	regimes present (slow-deep,	present (if fast-shallov			present (if fa		epth regime	
/	slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s,	missing, score lower to missing other regimes			or slow-shall ng, score lov		low-deep).	
1	deep is > 0.5 m.)	missing other regules	<i>j</i> .	are missi	ng, score 101	").		
SCORE	20 19 18 17 16	15 14 13 12	11	10 9	8 7 6	5 /	2 1	<u> </u>

		OW High Gradient Strea		Heavy deposits of fine	· · · · · · · · · · · · · · · · · · ·
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50- 80% for low-gradient)	material, increased bar development; more than 50% (80% for low- gradient) of the bottom	
	bottom affected by sediment deposition.	gradient) of the bottom affected; slight deposition in pools.	of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	changing frequently; pools almost absent due to substantial sediment deposition.	
SCORE	20 19 18 17 16	15 (4) 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow	Water reaches base of both	Water fills > 75% of the	Water fills 25-75% of	Very little water in	
Status X	lower banks, and minimal amount of channel substrate is exposed.	available channel; or < 25% of channel substrate is exposed.	the available channel, and/or riffle substrates are mostly exposed.	channel and mostly present as standing pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
6. Channel	Channelization or dredging	Some channelization present,	Channelization may be	Banks shored with	alteration
Alteration	absent or minimal; stream with normal pattern.	usually in areas of bridge abutments; evidence of past	extensive; embankments or shoring structures	gabion or cement; over 80% of the stream reach	more from
V		channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	present on both banks; and 40 to 80% of stream reach channelized and disrupted.	channelized and disrupted. Instream habitat greatly altered or removed entirely.	ursan Run off
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of	Occurrence of riffles	Occurrence of riffles	Occasional riffle or	Generally all flat water	
Riffles (or bends)	relatively frequent; ratio distance between riffles divided by width of the	infrequent; distance between riffles divided by the width of the stream is between 7 to	bend; bottom contours provide some habitat; distance between riffles	or shallow riffles; poor habitat; distance between riffles divided	Continuous riffle con be "good"
/	stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are	15. Riffles and Apore	divided by the width of the stream is between 15 to 25.	by the width of the stream is a ratio of > 25.	ve-softbet
•	continuous, placement of boulders or other large, natural obstruction is important.	Diffes are flore Distance between them vary		5.6 =	12-80ftbet Life \$45 avenue \$84wide
SCORE	20 19 18 17. 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
8. Bank Stability	Banks stable; evidence of	Moderately stable;	Moderately unstable;	Unstable; many eroded	
(score each bank)	erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	30-60% of bank in reach has areas of erosion; high erosion potential during floods.	areas; "raw" areas frequent along straight section and bends; obvious bank sloughing; 60-100% of bank has	
SCORE (LB)	Left Bank 10 9	8 7 6	5 . 4 3.	erosional scars.	
SCORE (RB)	Right Bank 10 9	8 7 6	3 4 3	20 1 0	
9. Vegetative	More than 90% of the	70-90% of the streambank	50-70% of the	Less than 50% of the	
Protection (score each bank)	streambank surfaces and immediate riparian zone covered by native vegetation,	surfaces covered by native vegetation, but one class of plants is not well-	streambank surfaces covered by vegetation, disruption obvious;	streambank surfaces covered by vegetation; disruption of	
	including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or	represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-	patches of bare soil or closely cropped vegetation common; less than one-half of the	streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in	
• .	mowing minimal or not evident; almost all plants allowed to grow naturally.	half of the potential plant stubble height remaining.	potential plant stubble height remaining.	average stubble height.	
SCORE (LB)	Left Bank 10 9	8 . 7 . 6	(0) 4 3	2 (1) 0	
SCORE (RB)	Right Bank 10 9	8 7 6	(C) 4 3	2 i 0	
10. Riparian	Width of riparian zone >18	Width of riparian zone 12-18 meters; human activities have	Width of riparian zone	With of riparian zone <	2
Vegetative Zone Width (score each bank)	meters; human activities (i.e., parking lots, roadbeds, clear- cuts, lawns, or crops) have not impacted zone.	impacted zone only minimally.	6-12 meters; human activities have impacted zone a great deal.	6 meters; little or no riparian vegetation due to human activities.	
SCORE (LB)	Left Bank 10 9	8 7 6)	3 4 3 3	2 0	
		and the state of t	The second secon	The state of the s	 4. (1) (2.5) (2.5) (2.5)

Total Score:

		OW HIGH GRACIER							
STREAM NAME:	Allen Fork Cen	ntral Brand			Centra	Brench			
STATION #: 5	MILE!			IN/WATE					
LAT.:	LONG.:		COU	NTY: 60	one	USGS 7.5 TC			
DATE: 11/3/09			INVE	ESTIGATO	ORS: Cra			V.T	TO, MarkL
TYPE SAMPLE:		brate FISH I	BACT.		""	,, , , , , , , , , , , , , , , , , , ,			
					. "-				
	ion, completion date			7		1			
WEATHER:	Now Past 24 hours				y rain in th	e last 7 days?			
Clorgy	☐ ☐ Heavy rain		Yes X	JINO	0C T 1		04 L	٠ - ٢	
Uler	☐ ☐Steady rain		tempera			s rainfall in past	∠4 nours_	→ in	
	Intermittent shows	ers <u> </u>	<u>∍ </u> % Clo	oud Cover					
	Clear/sunny			`			· · · · · · · · · · · · · · · · · · ·		
P-Chem: Temp (°C		% Saturation	pH (S.U		Cond.	Grab			
INSTREAM WAT	TERSHED	LOCAL WATERS			:		*		
FEATURES:		Predominant Surrour	nding La			·		.1	
Stream Width (riffl		Surface Mining	_	Constru		= "	rest/Silvicu		
Range of Pool Dept		Lawn	•	Commo			sture/Grazi	ıng	
Average Velocity	ft/s	Park		Industr		□Ha V	y 202 B ^	6/0 ±	n Carram
Est. Reach Length	ft*	☐Land Disposal / □	umps	☐Row C	rops	- Æ Ur	ban Runofi	n 300H	II DEMCIZ
	on entire restoration reach; not								
limited to 100 m se	9	Ctanam El				0.4	n Tv		
Hydraulic Structure	es: Diside	Stream Flow: ☐Dry ☐Pooled		د ا⊓	Normal	Stream	<u>m Type:</u> rennial [¬ı	rmittent
☐Dams	Bridge Abutments > bery	☐Dry ☐Pooled☐High ☐Very Ra			inounal		renniai [hemeral [
☐ Island	□Waterfalls	Littigii Livery R:	ախտ or 1	្ន		∟Ер	monicial [۲ .
Other	n. D T. /01 1 T	<u> </u>		_;	Charrie	Altantia	D:ca-	601	one
Riparian Vegetation		xa <u>Canopy Cover</u> ☐Fully Expos		%)	Channel Dreds	Alterations:	Riffle-ri		ope el type
Dominate Type	Shrubs lawn -	Partially Expos				ging inelization	Channel		
Trees Grasses						Partial)	Chaine	. ₽VUI.	
Number of strata	Herbaceous Ash/walnut	Fully Shade			الستوال	a.uai <i>)</i>			
		r any snace	- (,,,,-10			Dissilla Di	1 0/	T ~	distance of the
Stream Quality	Good (G) Fair (F)	Poor (P)	1		Score	Possible Pts	%	Cor	idition (G, F, P)
Rosgen C	>155 142-155	<142 <719/	Forme		95	1772	59	+	O .
Other	>77.5% 71-77.5%	<71%	Existin		_73	160	137	12.5	5
1			Future			1		4	
	(<2% slope) based on scoring of					sed on the follo			
	nay exclude #2, 3, and 7 below;					, Bank Stabi	nzation, 🗀	jfutur	
	elow; other exclusions on a site	specific basis.			-	n, Other		-1 -1	
Habitat		.		ition Cates		1	Dec		Comment
Parameter 1 Eniformal	Optimal Greater than 70% of substrate	Suboptimal			larginal	A T	Poor 1 20% stable		Comment
1. Epifaunal	Greater than 70% of substrate	40-70% mix of stable well-suited for full	naoitat;	20-40% n	mix of stable		n 20% stable ack of habit		
Substrate/	favorable for epifaunal colonization and fish cover;	colonization potential			iaditat itv less than		ack of nabli is; substrate		
Available Cover	mix of snags, submerged	adequate habitat for	,		; substrate		or lacking.	·	
	logs, undercut banks, cobble	maintenance of popula			y disturbed				
	or other stable habitat and at	presence of additional	ĺ	removed.		ļ			*
	stage to allow full	substrate in the form of				- 1			
l "	colonization potential (i.e.,	newfall, but not yet pr							
	logs/snags that are not new	for colonization (may	rate at	-		1			l
SCORE	fall and not transient).	high end of scale). 15 14 13 12	/ 11	10 (9)	8 7 (6 5 4	3 2 1	0	
SCORE 2. Embeddedness	Gravel, cobble, and boulder	Gravel, cobble, and be			obble, and		obble, and		
a. Pindeadeniess	particles are 0-25%	particles are 25-50%			particles are		particles are		
	surrounded by fine sediment.	surrounded by fine se	diment.		ounded by				
l `	Layering of cobble provides		•	sediment.		surround	ed by fine		
	diversity of niche space.					sediment			
SCORE	20 19 18 (17) 16	15 14 13 12					3 2 1	0	
3. Velocity/Depth	All four velocity/depth	Only 3 of the 4 regime			f the 4 habit			7	i
Regime	regimes present (slow-deep,	present (if fast-shallov			present (if f		depth regin		İ
X	slow-shallow, fast-deep, fast-	missing, score lower t		1	or slow-shal		slow-deep).	٠.	
1 ^	shallow). (Slow is < 0.3 m/s,	missing other regimes	s).	are missi	ng, score lo	ν»).		Ì	
SCORE	deep is > 0.5 m.)	15 14 12 12	11	10 0	8 7 4	6 8 4	3 2 1		
INCHES	1 201 19 18 17 IA	1 1.3 146 179 17		111					

		VRF Stream Quality Ass DOW High Gradient Strea	m Habitat Assessment	Data Sheet)	
4. Sediment	Little or no enlargement of	Some new increase in bar	Moderate deposition of	Heavy deposits of fine	
Deposition	islands or point bars and less	formation, mostly from	new gravel, sand or fine	material, increased bar	
	than 5% (< 20% for low-	gravel, sand or fine sediment;	sediment on old and	development; more than	
	gradient streams) of the	5-30% (20-50% for low-	new bars; 30-50% (50-	50% (80% for low-	
	bottom affected by sediment	gradient) of the bottom	80% for low-gradient)	gradient) of the bottom	
	deposition.	affected; slight deposition in	of the bottom affected;	changing frequently;	
V		pools.	sediment deposits at	pools almost absent due	
		į	obstructions,	to substantial sediment	
			constrictions, and	deposition.	
		į	bends; moderate		
		· · · · · · · · · · · · · · · · · · ·	deposition of pools		
SCORE	20 19 (18) 17 16	15 14 13 12 11	prevalent. 10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow	Water reaches base of both	Water fills > 75% of the	Water fills 25-75% of	Very little water in	
Status	lower banks, and minimal	available channel; or < 25%	the available channel,	channel and mostly	
X	amount of channel substrate	of channel substrate is	and/or riffle substrates	present as standing	
^	is exposed.	exposed.	are mostly exposed.	pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel	Channelization or dredging	Some channelization present,	Channelization may be	Banks shored with	
Alteration	absent or minimal; stream	usually in areas of bridge	extensive;	gabion or cement; over	
	with normal pattern.	abutments; evidence of past	embankments or	80% of the stream reach	
	·	channelization, i.e., dredging,	shoring structures	channelized and	
./		(greater than past 20 yr.) may	present on both banks;	disrupted. Instream	
<i> </i>		be present, but recent	and 40 to 80% of stream	habitat greatly altered or	
		channelization is not present.	reach channelized and	removed entirely.	
			disrupted.		
SCORE	20 19 18 17/16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of	Occurrence of riffles	Occurrence of riffles	Occasional riffle or	Generally all flat water	. 1
Riffles (or bends)	relatively frequent; ratio	infrequent; distance between	bend; bottom contours	or shallow riffles; poor	Continuous
1	distance between riffles	riffles divided by the width	provide some habitat;	habitat; distance	riffle con
	divided by width of the	of the stream is between 7 to	distance between riffles	between riffles divided	THINE CON
	stream < 7:1 (generally 5 to	15.	divided by the width of	by the width of the	he"good"
	7); variety of habitat is key.		the stream is between	stream is a ratio of > 25.	 /
	In streams where riffles are		15 to 25.		4
."	gontinuous, placement of				A. 10 1/4
distance to a	Phoulders or other large,				72
width 8	natural obstruction is				1000
SCORE	important.	15 H B B 11	10 9 8 7 6	5 4 3 2 1 0	19
	20 19 18 17 16 Banks stable; evidence of	Moderately stable;	Moderately unstable;	Unstable; many eroded	1,4 (***)
8. Bank Stability	erosion or bank failure absent	infrequent, small areas of	30-60% of bank in	areas; "raw" areas	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
(score each bank)		erosion mostly healed over.	reach has areas of	frequent along straight	ر ^ئ
	or minimal; little potential for future problems. < 5% of	5-30% of bank in reach has	erosion; high erosion	section and bends;	
	bank affected.	areas of erosion.	potential during floods.	obvious bank sloughing;	
V	bank affected.	areas of crosion.	potential during noods.	60-100% of bank has	
				erosional scars.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 (8) 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 (2) 3	2 1 0	
9. Vegetative	More than 90% of the	70-90% of the streambank	50-70% of the	Less than 50% of the -	
Protection (score	streambank surfaces and	surfaces covered by native	streambank surfaces	streambank surfaces	
each bank)	immediate riparian zone	vegetation, but one class of	covered by vegetation;	covered by vegetation;	
	covered by native vegetation,	plants is not well-	disruption obvious;	disruption of	
	including trees, understory	represented; disruption	patches of bare soil or	streambank vegetation	
	shrubs, or nonwoody	evident but not affecting full	closely cropped	is very high; vegetation	1
	macrophytes, vegetative	plant growth potential to any	vegetation common;	has been removed to 5	
V	disruption through grazing or	great extent; more than one-	less than one-half of the	centimeters or less in	
	mowing minimal or not	half of the potential plant	potential plant stubble	average stubble height.	
	evident; almost all plants	stubble height remaining.	height remaining.		
	allowed to grow naturally.			la	
	Left Brook 10 9	1 7 6	3 4 3	(8) 1 0	
	Right Berik 10 9	8 7 4 6	5 4 3	(3) 1 0	
SCORE (RB)		Width of riparian zone 12-18	Width of riparian zone	With of riparian zone <	
SCORE (RB) 10. Riparian	Width of riparian zone >18			1 6 1241	1
SCORE (RB) 10. Riparian Vegetative Zone	Width of riparian zone >18 meters; human activities (i.e.,	meters; human activities have	6-12 meters; human	6 meters; little or no	1
SCORE (LB) SCORE (RB) 10. Riparian Vegetative Zone Width (score	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-	meters; human activities have impacted zone only	activities have impacted	riparian vegetation due	
SCORE (RB) 10. Riparian Vegetative Zone	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have	meters; human activities have			
SCORE (RB) 10. Riparian Vegetative Zone Width (score each bank)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	meters; human activities have impacted zone only minimally.	activities have impacted zone a great deal.	riparian vegetation due to human activities.	
SCORE (RB) 10. Riparian Vegetative Zone Width (score	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear- cuts, lawns, or crops) have not impacted zone.	meters; human activities have impacted zone only	activities have impacted	riparian vegetation due	

		OW High Gradien						
STREAM NAME:	Alto fon K		LOCA	ATION:	Trib of	f Central)	Branch A	arested
STATION#: 5	MILE:		BASI	N/WATE	ERSHED:		,	
LAT.:	LONG.:		COU	ىدا: NTY	one	USGS 7.5 TO		· · · · · · · · · · · · · · · · · · ·
DATE: \1 / 3 10			INVE	STIGAT	ORS: (n	stal C Di	Caronin	T NO MENOR
TYPE SAMPLE:		brate □FISH □F	BACT.)		7,
Ctream rectorat	ion, completion date							•
		Uar	o thora ha	en a hear	n, rain in th	e last 7 days?		
WEATHER:	Now Past 24 hours Heavy rain		Yes X		y ram m un	c last / days:		
8:	Steady rain		temperat		°C Inches	rainfall in nast	24 hours -5 in	1.
" loid	Intermittent show	ers 7	S% Clo			· · · · · · · · · · · · · · · · · · ·	<u></u>	
<i>€</i> 7°	☐ ☐Clear/sunny	<u></u>	<u>o</u> /0 010	uu ÇOVO			,	
P-Chem: Temp (°C		% Saturation	pH (S.U)	<u> </u>	Cond.	□Grab		
INSTRÉAM WAT		LOCAL WATERSI					•	
FEATURES:	13 over)	Predominant Surrour			~			
Stream Width (riffl		Surface Mining		Const	ruction	⊠ For	rest/Silviculture	
Range of Pool Dep		Lawn	•	∠ Comm	nercial	☐Pas	sture/Grazing	
Average Velocity	ft/s	2 Park		■Indust		∐Ha		
Est. Reach Length	ft*	☐Land Disposal / D)umps	□Row (Drops	₩Url	ban Runoff/Stor	m Sewers
	on entire restoration reach; not							
limited to 100 m se								·
Hydraulic Structure		Stream Flow:		□ ∗ .		Stream	n Type: rennial	ama istant
Dams	Bridge Abutments	Dry Pooled		Low	☐Normal		hemeral See	
☐ Island	□Waterfalls	☐High ☐Very Ra	apid or 10	orrentiai		FTED	nemerai 🗀 See	.h
Other					Channel	Altarations	Riffle-riffle s	lone
Riparian Vegetation			and (0.25)	26)	Dred	Alterations:	Rosgen chang	
Dominate Type Trees	Shrubs Maple / Oak	Partially Expos				nelization	Channel Evol	
Grasses	Shrubs not which hall old							
Number of strata	Literoaccous hopes beco	✓ Partially Shade	ed (75-10))%)	(
	Cond (C) Fair (F)	· · · · · · · · · · · · · · · · · · ·			Score	Possible Pts	% Co	ndition (G, F, P)
Stream Quality	Good (G) Fair (F) >155 142-155	<u>Poor (P)</u> <142	Former		DONG	POSSIBIE: IS	/6 CO	nation (O, 1, 1)
Rosgen C Other	>77.5% 71-77.5%		Existin	the second second second	82	100	22	Bo.
Ottici	71-77.576	*7170	Future					
NOTE D	(ma)	C-11 10	S. 18 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	STATE OF THE STATE OF		and on the falls	wing: 🔲 In-Stre	am Wakitat
NOIE: Rosgen C ((<2% slope) based on scoring or nay exclude #2, 3, and 7 below;	Passon A/P may					ization, Futu	
evalude #2 and 5 h	elow; other exclusions on a site	enecific hasis			Vegetation		ireanori, La cus	
Habitat	Ciow, other exclusions on a site	specific basis.		tion Cate		.,		
Parameter	Optimal	Suboptimal			/Iarginal		Poor	Comment
1. Epifaunal	Greater than 70% of substrate	40-70% mix of stable			mix of stabl	e Less than	20% stable	
Substrate/	favorable for epifaunal	well-suited for full	, ,	habitat;			ack of habitat	
Available Cover	colonization and fish cover;	colonization potential;	;		lity less than	is obviou	is; substrate	./x
	mix of snags, submerged	adequate habitat for			e; substrate		or lacking.	5
1	logs, undercut banks, cobble	maintenance of popula			tly disturbed	or		121
V	or other stable habitat and at	presence of additional substrate in the form of		removed	I.			P
	stage to allow full colonization potential (i.e.,	newfall, but not yet pr						150
	logs/snags that are not new	for colonization (may						1
	fall and not transient).	high end of scale).						
SCORE	20 19 18 17 16	15 14 13 12		10 9	876	6 5 4	3 2 (1) 0	
2. Embeddedness	Gravel, cobble, and boulder	Gravel, cobble, and bo	oulder		cobble, and	Gravel, c	obble, and	No
	particles are 0-25%	particles are 25-50%			particles are		particles are	Material
	surrounded by fine sediment.	surrounded by fine see	diment.		rounded by			oe embed
	Layering of cobble provides		, .	sedimen	it.		ed by fine	05 +-
\	diversity of niche space.		2.14	10 0	o =	sediment		
SCORE	20 19 18 17 16	15 14 13 12		10 9				1
3. Velocity/Depth	All four velocity/depth	Only 3 of the 4 regime present (if fast-shallow			of the 4 habit present (if f		ea by 1 depth regime	
Regime	regimes present (slow-deep, slow-shallow, fast-deep, fast-	missing, score lower t			or slow-shal		slow-deep).	
								1
X						ow).		
X	shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	missing other regimes			sing, score lo	ow).		

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NKSWRF Stream Quality Assessment Data Sheet

4. Sediment	Little or no enlargement of	OOW High Gradient Strea Some new increase in bar	Moderate deposition of	Heavy deposits of fine	S1
Deposition	islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low- gradient) of the bottom affected; slight deposition in	new gravel, sand or fine sediment on old and new bars; 30-50% (50- 80% for low-gradient) of the bottom affected;	material, increased bar development; more than 50% (80% for low- gradient) of the bottom changing frequently;	Spil Beilded Stream
✓ <u>.</u>	deposition.	pools.	sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	pools almost absent due to substantial sediment deposition.	
SCORE	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate	Water fills > 75% of the available channel; or < 25% of channel substrate is	Water fills 25-75% of the available channel, and/or riffle substrates	Very little water in channel and mostly present as standing	
SCORE	is exposed. 20 19 18 17 16	exposed. 15 14 13 12 11	are mostly exposed.	pools. 5 4 3 2 1 0	
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging,	Channelization may be extensive; embankments or shoring structures	Banks shored with gabion or cement; over 80% of the stream reach channelized and	
CODE	20 10 18 17 72	(greater than past 20 yr.) may be present, but recent channelization is not present.	present on both banks; and 40 to 80% of stream reach channelized and disrupted.	disrupted. Instream habitat greatly altered or removed entirely.	
SCORE 7. Frequency of	20) 19 18 17 16 Occurrence of riffles	15 14 13 12 11 Occurrence of riffles	10 9 8 7 6 Occasional riffle or	5 4 3 2 1 0 Generally all flat water	
Riffles (or bends)	relatively frequent; ratio	infrequent, distance between	bend; bottom contours	or shallow riffles; poor	condion
	distance between riffles divided by width of the	riffles divided by the width of the stream is between 7 to	provide some habitat; distance between riffles	habitat; distance between riffles divided	r: 6/2
A STATE OF THE STA	stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of	15.	divided by the width of the stream is between 15 to 25.	by the width of the stream is a ratio of > 25.	be sood
	boulders or other large, natural obstruction is important.				500-1
SCORE	20 19 18 17 16	15 14 13 12 14	10 9 8 7 6	5 4 3 2 1 9	
8. Bank Stability	Banks stable; evidence of erosion or bank failure absent	Moderately stable; infrequent, small areas of	Moderately unstable; 30-60% of bank in	Unstable; many eroded areas; "raw" areas	Frizbee
(score each bank)	or minimal; little potential for future problems. < 5% of bank affected.	erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	reach has areas of erosion; high erosion potential during floods.	frequent along straight section and bends; obvious bank sloughing:	Golf Trail
V				60-100% of bank has erosional scars.	ceases
SCORE (LB)	Left Bank (10 (9)	7	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 /9	3 7 6	3	2 1 0	4.7
9. Vegetative	More than 90% of the streambank surfaces and	70-90% of the streambank surfaces covered by native	50-70% of the streambank surfaces	Less than 50% of the	
Protection (score each bank)	immediate riparian zone covered by native vegetation,	vegetation, but one class of plants is not well-	covered by vegetation; disruption obvious;	streambank surfaces covered by vegetation; disruption of	
V	including trees, understory shrubs, or nonwoody macrophytes; vegetative	represented; disruption evident but not affecting full plant growth potential to any	patches of bare soil or closely cropped vegetation common;	streambank vegetation is very high; vegetation has been removed to 5	
	disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	great extent; more than one- half of the potential plant stubble height remaining.	less than one-half of the potential plant stubble height remaining.	centimeters or less in average stubble height.	
SCORE (LB)	Leadaine 10 9	8 (7) 6		2 1 0	
SCORE (RB)	Biggle (a) (a) (b) (b)	8 7 6		2 1 0	
10. Riparian	Width of riparian zone >18	Width of riparian zone 12-18 meters; human activities have	Width of riparian zone	With of riparian zone <	Golf Cairs
Vegetative Zone Width (score	meters; human activities (i.e., parking lots, roadbeds, clear-	impacted zone only	6-12 meters; human activities have impacted	6 meters; little or no riparian vegetation due	
each bank)	cuts, lawns, or crops) have not impacted zone.	minimally.	zone a great deal.	to human activities.	
SCORE (LB)	Left Bank 10 9	11 (b) 6 1 (b) 7	<u> 4</u> 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0	

Total Score:

NOTES/COMMENTS:

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NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

STREAM NAME:	Allen Fork	, Soul	th Branch	LOC	ATION:	South	Branch no	forested	below culvert
STATION #:	MIL	.E:				ERSHED:		<u> </u>	·
LAT.:	LONG.:			COU	NTY:	me	USGS 7.5 TO		
DATE: 11 /13/09			Devoy* Fil	INVI	ESTIGA'	IORS: Cuy	stal C, Dian	nea W, .	TM, Marke
TYPE SAMPLE:		croinverteb	rate FISH	BACT.		U			
	ion, completion date	,	, 17_	a thous h	an a haa	ray noin in 4L	a last 7 days?		
WEATHER:	Now Past 24 hou Heavy r			s inere be Yes [vy rain in th	e last 7 days?	أجو	-
action to	☐ ☐ Steady r					°C. Inches	s rainfall in past	24 hours	in.
				5 % Clo			F-200		
	⊠ □Clear/su		·				<u> </u>		
P-Chem: Temp (°C			% Saturation	pH (S.U	D	Cond.	☐Grab		
INSTREAM WAT			LOCAL WATERS			S:			
FEATURES:	·		Predominant Surrous	nding La			_		
Stream Width (riffl		ft	Surface Mining		Cons		=	est/Silvicul	
Range of Pool Dep	ths $\frac{\cancel{\cancel{4}}\cancel{\cancel{6}}}{\cancel{\cancel{1}}}$	·_	⊠Lawn		Com			ture/Grazin	ıg
Average Velocity	ft/	S	Park Land Disposal / I	lumne	☐Indus		☐Ha		Storm Sewers
Est. Reach Length	on entire restoration re		Tranci Disposal / L	varith9	LIKOW.	Ciops	النجي	wi Kululi/	Owill DOWELS
limited to 100 m se		11Ut							
Hydraulic Structure			Stream Flow:		1		Stream	Type:	_
□Dams	☐Bridge Abutments	s	Dry Pooled		Low	□Normal	i _∏Per	ennial E	Intermittent
Island	■Waterfalls	ł	☐High ☐Very R	apid or T	orrential		□Epi	nemeral [Seep
Dother Coulve								T	
Riparian Vegetation	n: Dom. Tree	/Shrub Tax	ca <u>Canopy Cover</u> Fully Expos	:			Alterations:	Riffle-rif	
Dominate Type	Паь		Fully Expos	sed (0-25	%) 5.500/\	Dred			channel type Evol. Model
☐Trees ☑Grasses	☐Shrubs ☐Herbaceous		☐ Partially Ex☐ Partially Sh				nelization ☐Partial)	Chamiei	Evol. Model
Number of strata			Fully Shade			More			
	Good (C)	Foir (F)				Score	Possible Pts	%	Condition (G, F, P)
Stream Quality Rosgen C	Good (G) >155	Fair (F) 142-155	<u>Poor (P)</u> <142	Forme		Score	Possible Pts	70	Condition (U, F, F)
Other		71-77.5%	<71%	Existin		73	120	46	p
Julio	- 1,10,0			Future					
NOTE: Passen C.	(<2% slope) based on	scoring of	all 10 narameters	96 ST \$ 25 TO	177	are score he	sed on the falla	ving: Tin	-Stream Habitat,
	hay exclude #2, 3, and						, □Bank Stabil		
	elow; other exclusion:					n Vegetation		1.00	
Habitat					tion Cat				
Parameter	Optimal		Suboptimal			Marginal		Poor	Comment
1. Epifaunal	Greater than 70% of		40-70% mix of stable	habitat;		mix of stabl		20% stable	1 (2) (/// 1/)
Substrate/	favorable for epifaun		well-suited for full			habitat ility less than	,	ick of habita s; substrate	" Credit
Available Cover	colonization and fish mix of snags, submer	1	colonization potential adequate habitat for	,		le; substrate		or lacking.	CASOL, 'VII
	logs, undercut banks,	, cobble	maintenance of popul			tly disturbed			to Newtall
	or other stable habita		presence of additional		remove	d.			that has
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	stage to allow full	165	substrate in the form of						to Newfell that has Jammed the stream
	colonization potentia logs/snags that are no		newfall, but not yet pr for colonization (may		1				the stream
	fall and not transient		high end of scale).	ian at					400.3
SCORE	20 19 18 17		15 14 13 12		10 9	8 7 (3 2 (1)	(0)
2. Embeddedness	Gravel, cobble, and b	oulder	Gravel, cobble, and be	oulder		cobble, and		obble, and	5
\sim	particles are 0-25%	ا ا	particles are 25-50%	dim	boulder	particles are	50- boulder p	articles are	The state of the s
	surrounded by fine se Layering of cobble p		surrounded by fine se	uiment.	75% su sedime	rrounded by		od by fine	Control of
	diversity of niche spa		•		- Scamic		sediment		Silt bed
SCORE	20 19 18 17		15 14 13 12	11	10 9	8 7		3 2 1	
3. Velocity/Depth	All four velocity/dep	th	Only 3 of the 4 regime	es	Only 2	of the 4 habi	tat Dominate	d by 1	
Regime	regimes present (slov	w-deep,	present (if fast-shallow	w is	regimes	s present (if f	ast- velocity/	lepth regime	•
*	slow-shallow, fast-de		missing, score lower t		1	or slow-shal	1 '	slow-deep).	
	shallow). (Slow is <	v.3 m/s,	missing other regimes	i)	are mis	sing, score lo	iw).		
SCORE	deep is > 0.5 m.)	16	15 14 13 12	11	10 9	8 7	6 5 4	3 2 1	0

beposition bilands or point bars and less than 5% (< 20% for forward particular streams) of the bottom affected by sediment deposition. bilands or point bars and less than 5% (< 20% for forward by sediment deposition). bilands or point bars and less than 5% (< 20% for forward by sediment deposition). bilands or point bars and less sediment on old and not been sediment on old and not been sediment deposition. bilands or point bars and less sediment deposition in point and the sediment deposition in point and the sediment deposition. bilands or point bars and less sediment deposition in point and the sediment deposition in point and the sediment deposition. bilands or point bars and less sediment deposition in point and the sediment deposition in point and the sediment deposition in point and the sediment deposition. bilands and the sediment deposition in point and the sediment deposition in the sediment deposition in the sediment deposition in point and the sediment deposition in point and the sediment deposition in point and the sediment deposition in			OW High Gradient Strea		Data Sheet)	
Score Setting Water fills 2-75% of belower banks, and minimal amount of channel substrate is exposed. Score	4. Sediment Deposition	islands or point bars and less than 5% (< 20% for low- gradient streams) of the bottom affected by sediment	formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low- gradient) of the bottom affected; slight deposition in	new gravel, sand or fine sediment on old and new bars; 30-50% (50- 80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools	development; more than 50% (80% for low- gradient) of the bottom changing frequently; pools almost absent due to substantial sediment	
SCORE 20 19 18 17 16 S. Channell: Some channell: action of redging absent or minimal; stream with normal pattern. SCORE 20 19 18 17 16 Some channell: action appears the stream is pattern. SCORE 20 19 18 17 16 Some channell: action and increase the stream is pattern. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channell: action is not present. SCORE 20 19 18 17 16 Some channel: action is not present. SCORE 20 19 18 17 16 Some channel: action is not present. SCORE 20 19 18 17 16 Some channel: action is not present. SCORE 20 19 18 17 16 Some channel: action is not present. SCORE 20 19 18 17 16 Some channel: action is not present. SCORE 20 19 18 17 16 Some channel: action of present. SCORE (LB) Left Bank 10 9 Some channel: activities (is not channel: action of present is not will be presented; distinguish in creach has areas of crossion. SCORE (LB) Left Bank 10 9 Some channel: activities (is not channel:	SCORE 5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate	Water fills > 75% of the available channel; or < 25% of channel substrate is	Water fills 25-75% of the available channel, and/or riffle substrates	Very little water in channel and mostly present as standing	
Alteration Channelization or dredging about nor minimal; stream with normal pattern. SCORE 20.19 18 17 19 T. Frequency of Riffles (or bends) T. Frequency of Riffles (or bends) SCORE 20.19 18 17 46 SCORE 10.00 19 18 17 46 SCORE 20.19 18 17 46 SCORE (AB) SCORE (BB) SCORE (CB) SCORE	SCORE					Arra Cara
7. Frequency of Riffles (or bends) Riffles (o	6. Channel	Channelization or dredging absent or minimal; stream	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	Chanel to
elatively frequent; ratio distance between riffles divided by width of the stream is between 7 to 7; variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. SCORE 8. Bank Stability (score each bank) SCORE (LB) SCORE (LB) SCORE (LB) Left Bank 10 9 8. Core (LB) Left Bank 10 9 8 10 9 8 10 10 10 10 10 10 10 10 10	SCORE					
SCORE (LB) SCORE (LB) SCORE (LB) And the stability of the streambank surfaces and immediate riparian zone cach bank) SCORE (LB) SCORE (L	7. Frequency of Riffles (or bends)	relatively frequent; ratio distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is	infrequent; distance between riffles divided by the width of the stream is between 7 to	bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between	or shallow riffles, poor habitat, distance between riffles divided by the width of the	riffles con be
8. Bank Stability (score each bank) Banks stable; evidence of erosion or bank failure absent or minimal, little potential for future problems. < 5% of bank affected. SCORE (LB) Left Bank 10 9 5 7 6 5 3 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	SCORE		K 14 19 12 11	10 9 8 7 6	5 4 3 2 1 0	19. 30. 36.
SCORE (LB) Left Bank 10 9 8 7 6 5 3 2 1 0 9. Vegetative Protection (score each bank) More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. SCORE (LB) SCORE (LB) SCORE (RB) Right Bank 10 9 8 7 6 5 3 2 1 0 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. SCORE (LB) SCORE (RB) Right Bank 10 9 8 7 6 5 3 2 1 0 70-90% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped, vegetation common; less than one-half of the potential plant stubble height remaining. SCORE (LB) SCORE (LB) Left Bank 10 9 8 7 6 9 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped, vegetation common; less than one-half of the potential plant stubble height remaining. SCORE (LB) Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clearcach bank) Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. Width of riparian zone of 12-18 meters; human activities have impacted zone only minimally. Width of riparian zone of 12-18 meters; human activities have impacted zone only minimally. SCORE (LB) Left Bank 10 9 8 7 6 9 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped, vegetation common; less than one-half of the potential plant stubble height remaining. Vegetative Zone Width of riparian zone of 12-18 meters; human activities have impacted zone only minimally. Width of riparian zone of meters; little or no riparian vegetation due to human activiti	8. Bank Stability	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has	Moderately unstable, 30-60% of bank in reach has areas of erosion; high erosion	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; obvious bank sloughing; 60-100% of bank has	
SCORE (RB) Right Hank 10 9 More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. SCORE (LB) SCORE (RB) Right Hank 10 9 Roce than 90% of the streambank surfaces covered by native vegetation, immediate riparian zone covered by native vegetation, but one class of plants is not well-represented; disruption obvious; patches of bare soil or closely cropped, vegetation common, less than one-half of the potential plant stubble height remaining. SCORE (LB) SCORE (RB) Right Hank 10 9 More than 90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption obvious; patches of bare soil or closely cropped, vegetation common, less than one-half of the potential plant stubble height remaining. SCORE (LB) SCORE (RB) Right Hank 10 9 More than 90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption obvious; patches of bare soil or closely cropped, vegetation common, less than one-half of the potential plant stubble height remaining. SCORE (LB) SCORE (RB) Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. Width of riparian zone 6 meters; human activities have impacted zone only minimally. SCORE (LB) Lett Bank 10 9 Right Hank 10 9 Roce and by active streambank surfaces covered by vegetation, disruption obvious; patches of bare soil or closely cropped, vegetation common, less than non-half of the potential plant stubble height remaining. SCORE (LB) Width of riparian zone 6 Midth of riparian z	SCORE (LB)	Left Bank 10 9		3 (A) 3		
More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. SCORE (LB) Left Bank More than 90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. SCORE (LB) Left Bank More than 90% of the streambank surfaces covered by vegetation, disruption of obscivus; patches of bare soil or evident; almost all plants allowed to grow naturally. SCORE (LB) Left Bank More than 90% of the streambank surfaces covered by vegetation, disruption obvious; patches of bare soil or evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. SCORE (LB) Left Bank 70-90% of the streambank surfaces covered by vegetation; disruption of is very high; vegetation has been removed to 5 centimeters or less in average stubble height.— Width of riparian zone 6-12 meters; human activities nave impacted zone only minimally. Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. Width of riparian zone or riparian vegetation due to human activities.	SCORE (RB)					41 MARKET E
SCORE (LB) Left Bark 10 9 8 7 6 9 4 3 2 1 0 SCORE (RB) Rich Bark 10 9 8 7 6 9 4 3 2 1 0 10. Riparian Vegetative Zone Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone. SCORE (LB) Left Bark 10 9 8 7 6 9 4 3 2 1 0 Width of riparian zone 2-18 meters; human activities have impacted zone only minimally. SCORE (LB) Left Bark 10 9 8 7 6 9 4 3 2 1 0 Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. SCORE (LB) Left Bark 10 9 8 7 6 9 4 3 2 1 0	9. Vegetative Protection (score	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in	
10. Riparian Vegetative Zone Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone. SCORE (LB) Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone. Width of riparian zone 6-12 meters; human activities have impacted zone only minimally. SCORE (LB) Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. Width of riparian zone 6 meters; little or no riparian vegetation due to human activities.	SCORE (LB)		8 7 6	3	2) 1 0	
	SCORE (RB) 10. Riparian Vegetative Zone Width (score each bank)	Rich Bink 10 9 Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear- cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	With of riparian zone < 6 meters; little or no riparian vegetation due to human activities.	
	SCORE (LB) SCORE (RB)	Left Bank 10 9 Right Bank 10 9	8 (2) (6) 8 7 6	3 3 4 3	2 1 0 2 1 0	

Total Score:

NOTES/COMMENTS:

55

NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

				A		T 7	
STREAM NAME:	Affen Fork S	ath Bruch	LOCATION	: South Bronc	h force	ted -	Was and Me
STATION #:			BASIN/WA	TERSHED:			
LAT.:	LONG.:		COUNTY:	Boone US	GS 7.5 TOP		
DATE: ////3/08		·	INVESTIGA	ATORS: Crystal	C. Dian	nea. W. J1	M. Mark L.
TYPE SAMPLE:	P-CHEM Macroinvertel	brate	BACT.				/
	ion, completion date						
WEATHER:	Now Past 24 hours			avy rain in the last	t 7 days?		
	☐ ☐ Heavy rain		Yes 🖾 No	•		4	
O Jan.	☐ ☐Steady rain}	Air	r temperature	°C. Inches rain	fall in past 2	4 hours 0.4	in.
l	☐ Intermittent show	ors thin 10	0 % Cloud Cov	/er			
	☐ ☐ Clear/sunny			· · · · · · · · · · · · · · · · · · ·			
P-Chem: Temp (°C	D.O. (mg/l)	% Saturation	pH (S.U)	Cond.	Grab		
INSTREAM WAT		LOCAL WATERS				- 	
FEATURES:		Predominant Surrous			منت	are all	
Stream Width (riffl		Surface Mining		struction		st/Silvicultur	re
Range of Pool Dep		Lawn		nmercial		ure/Grazing	
Average Velocity	ft/s	Park			□Hay	D 000.	.mm Carrer
Est. Reach Length		☐Land Disposal / D	Jumps ∐Rov	v Crops	∠ \$Urba	an Runoff/Sto	niii sewers
	on entire restoration reach; not						
limited to 100 m se		C4				Т	
Hydraulic Structure	es:	Stream Flow:	∖ г⊀-	, []Ni	Stream	Type: nnial	tammittant
☐ Dams	Bridge Abutments	Dry Pooled				nnial ∠Hn emeral □Se	
☐Island ☐Other	Waterfalls	☐High ☐Very Ra	apiu or romentia	u	⊔ври	omerat [136	cc p
Other Dinarian Vacatation	on: Dom. Tree/Shrub Ta	xa Canopy Cover	•	Channel Alte	rations. I	Riffle-riffle	slone
Riparian Vegetatio				Channel Alte ☐Dredging		Riffle-riffle Rosgen char	
Dominate Type Trees	Shrubs Mark / Hick	744	1 (0.0 000)			Channel Eve	
Grasses	Herhaceous What SMALL	Partially Ch	.p0566 (25-5076) aded (50-75%)			Cammidi EV	
Number of strata	Herbaceous White Snake	Fully Shade	:d (75-100%)	' '			
				Score Po	esible Pts	% C	Condition (G, F, P)
Stream Quality	Good (G) Fair (F) >155 142-155	<u>Poor (P)</u> もこう <142 84	Former	DAME 16	ISSIVIÇ FIS	70 E	ARIMAPH (U, F, F)
Rosgen C	>135 142-133 >77.5% 71-77.5%		Existing	76	40	81	
Other	-11.3%	1170		7	'' 	3.7	
		C 11 4 0	A SHOULD FEET CONTRACTOR OF THE PROPERTY OF TH	 	-) 1		
NOTE: Rosgen C ((<2% slope) based on scoring of	all 10 parameters	Thron o	mure score based o	n use follow	ing: ∐in-Sti	cam Habitat,
below; Rosgen E n	nay exclude #2, 3, and 7 below;	ROSGEN A/B may		n Restoration, Di		cauon, Litut	me .
	elow; other exclusions on a site	specific dasis.		an Vegetation,	Outer		
Habitat	0-41	Cult	Condition Ca		T	Poor	Comment
Parameter 1 Eniformal	Optimal Greater than 70% of substrate	Suboptimal 40-70% mix of stable	habitate 20 400	Marginal % mix of stable	Less than 2		Comment
1. Epifaunal Substrate/	favorable for epifaunal	well-suited for full	,	% mix of stable it; habitat	1	20% stable	·
Available Cover	colonization and fish cover;	colonization potential		bility less than	is obvious;		
ZZY SINSUIC CUYET	mix of snags, submerged	adequate habitat for	desiral	ble; substrate	unstable or		
·	logs, undercut banks, cobble	maintenance of popula	ations, freque	ently disturbed or		-	1 /
1/	or other stable habitat and at	presence of additional	l remov		N.		1
l "	stage to allow full	substrate in the form of					
	colonization potential (i.e.,	newfall, but not yet pr for colonization (may					1
•	logs/snags that are <u>not</u> new fall and <u>not</u> transient).	high end of scale).					1
SCORE	20 19 18 17 16		11 (10)	9 8 7 6	5 4 3	2 1 0	
2. Embeddedness	Gravel, cobble, and boulder	Gravel, cobble, and be		l, cobble, and	Gravel, col		
	particles are 0-25%	particles are 25-50%	boulde	er particles are 50-	boulder pa	rticles are	
	surrounded by fine sediment.	surrounded by fine see	diment. 75% s	surrounded by fine	more than	75%	
1	Layering of cobble provides		sedim	ent.	surrounded	i by fine	1 /
SCORE	diversity of niche space.	12 12 600 12		0 6 7 7	sediment.	Property Commence	V 28 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
SCORE	20 19 18 17 16	15 14 (13) 12		9 8 7 6		2 1 0	
3. Velocity/Depth	All four velocity/depth	Only 3 of the 4 regime		2 of the 4 habitat	Dominated		
Regime	regimes present (slow-deep, slow-shallow, fast-deep, fast-	present (if fast-shallov missing, score lower t		es present (if fast- w or slow-shallow	(usually sle	epth regime ow-deen).	,
1 7	shallow). (Slow is < 0.3 m/s,	missing other regimes		issing, score low).	(would be	о чоор <i>)</i> .	1
	deep is > 0.5 m.)	- Saint to Suite			1		
SCORE	20 10 19 17 16	15 14 12 12	11 10	0 9 7 6	E 4. 2	2 1 0	Calculation of the Calculation

5

NKSWRF Stream Quality Assessment Data Sheet

		DOW High Gradient Strea			
4. Sediment Deposition	Little or no enlargement of islands or point bars and less	Some new increase in bar formation, mostly from	Moderate deposition of new gravel, sand or fine	Heavy deposits of fine material, increased bar	
	than 5% (< 20% for low- gradient streams) of the	gravel, sand or fine sediment; 5-30% (20-50% for low-	sediment on old and new bars; 30-50% (50-	development; more than 50% (80% for low-	
-	bottom affected by sediment	gradient) of the bottom	80% for low-gradient)	gradient) of the bottom	
,	deposition.	affected; slight deposition in	of the bottom affected;	changing frequently;	
✓	•	pools.	sediment deposits at	pools almost absent due	
			obstructions,	to substantial sediment	
			constrictions, and bends; moderate	deposition.	
			deposition of pools		
			prevalent.		
SCORE 5. Channel Flow	20 19 18 17 16 Water reaches base of both	(15) 14 13 12 11 Water fills > 75% of the	10 9 8 7 6	5 4 3 2 1 0	
Status	lower banks, and minimal	available channel; or < 25%	Water fills 25-75% of the available channel,	Very little water in channel and mostly	
X	amount of channel substrate	of channel substrate is	and/or riffle substrates	present as standing	
~ \	is exposed.	exposed.	are mostly exposed.	pools.	
SCORE	20 10 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
6. Channel Alteration	Channelization or dredging absent or minimal; stream	Some channelization present, usually in areas of bridge	Channelization may be extensive;	Banks shored with	
AICI BUUII	with normal pattern.	abutments; evidence of past	embankments or	gabion or cement; over 80% of the stream reach	
V		channelization, i.e., dredging,	shoring structures	channelized and	
·		(greater than past 20 yr.) may	present on both banks;	disrupted. Instream	
٠.,		be present, but recent	and 40 to 80% of stream	habitat greatly altered or	
		channelization is not present.	reach channelized and disrupted.	removed entirely.	
SCORE	20 19 18 17 (6)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of	Occurrence of riffles	Occurrence of riffles	Occasional riffle or	Generally all flat water	
Riffles (or bends)	relatively frequent; ratio	infrequent; distance between	bend; bottom contours	or shallow riffles; poor	Continue
	divided by width of the	riffles divided by the width of the stream is between 7 to	provide some habitat; distance between riffles	habitat; distance between riffles divided	-41.
	stream < 7:1 (generally 5 to	15.	divided by the width of	by the width of the	fittle con
	7); variety of habitat is key.	46	the stream is between	stream is a ratio of > 25.	Continuous Fiffle con be "good"
·	In streams where riffles are	· -	15 to 25.		/
	continuous, placement of boulders or other large,				
	natural obstruction is				'
SCORE	important.				200 2.74 (0)
8. Bank Stability	20 19 18 17 16 Banks stable; evidence of	15 14 13 #2 11 Moderately stable;	10 9 8 7 6 Moderately unstable;	5 4 3 2 1 0 Unstable; many eroded	***
(score each bank)	erosion or bank failure absent	infrequent, small areas of	30-60% of bank in	areas; "raw" areas	
(,	or minimal; little potential for	erosion mostly healed over.	reach has areas of	frequent along straight	
1/	future problems. < 5% of	5-30% of bank in reach has	erosion; high erosion	section and bends;	
•	bank affected.	areas of erosion.	potential during floods.	obvious bank sloughing; 60-100% of bank has	
				erosional scars.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3 1	ا راي	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 (1) 0	
9. Vegetative Protection (score	More than 90% of the streambank surfaces and	70-90% of the streambank surfaces covered by native	50-70% of the streambank surfaces	Less than 50% of the	
each bank)	immediate riparian zone	vegetation, but one class of	covered by vegetation;	streambank surfaces covered by vegetation;	
, , , , , , , , , , , , , , , , , , ,	covered by native vegetation,	plants is not well-	disruption obvious;	disruption of	
	including trees, understory	represented; disruption	patches of bare soil or	streambank vegetation	
\checkmark	shrubs, or nonwoody macrophytes; vegetative	evident but not affecting full plant growth potential to any	closely cropped vegetation common;	is very high; vegetation has been removed to 5	
*	disruption through grazing or	great extent; more than one-	less than one-half of the	centimeters or less in	
	mowing minimal or not	half of the potential plant	potential plant stubble	average stubble height.	
	evident; almost all plants allowed to grow naturally.	stubble height remaining.	height remaining.		,
SCORE (LB)		û 7 6	5 4 3	2	en Paulin Arry Prince anna.
SCORE (RB)	Right Bank 10 9	8 7 60	3 4 3 5 4 3	2 1 0	
10. Riparian	Width of riparian zone >18	Width of riparian zone 12-18	Width of riparian zone	With of riparian zone <	1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Vegetative Zone	meters; human activities (i.e.,	meters; human activities have	6-12 meters; human	6 meters; little or no	
Width (score	parking lots, roadbeds, clear-	impacted zone only	activities have impacted	riparian vegetation due	
each bank)	cuts, lawns, or crops) have not impacted zone.	minimally.	zone a great deal.	to human activities.	
SCORE (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 4 9 0	
SCORE (RB)	Right Benk 10 9	3 (6)	5 A 3	2 1 0	
		NOTES/COMMENTS:	and the state of t		17.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.

Total Score:

86

NOTES/COMMENTS:

APPENDIX C – EROSION CONTROL PRACTICES (ECP)

<u>PURPOSE</u> - The purpose of these ECPs is to minimize the release of soil / sediment to streams from disturbed areas. Emphasis is on erosion prevention rather than trying to capture released sediments.

<u>PERMITS & NOTIFICATIONS</u> – In addition to obtaining all necessary permits, KPDES will be given 48 hours notice and Sanitation District 1 will be given 72 hours notice (for projects within SD1 jurisdiction) prior to soil disturbance activity exceeding one acre. (See Plan for permitting requirements.)

GENERAL PRACTICES — One of the primary purposes of stream and wetland restoration is **long-term** mitigation of erosion and sedimentation, through restoring floodplain connectivity, bank and channel stabilization, re-forestation of riparian buffers, etc. The following general practices will be implemented during and after soil disturbance activities to minimize **short term** erosion:

- 1. Existing vegetation and root structures will be **preserved and protected** to the extent practicable.
- 2. Construction activities will be **scheduled** to avoid high stream levels, excessively wet soils, anticipated rain, extended periods of unprotected soils, and unfavorable seasons for rapid vegetative cover establishment (winter). Pump-around and/or sediment collection practices will be implemented as necessary.
- 3. During exposed soil conditions, practices will be **inspected** at least weekly and after ½-inch or more of rain. Any necessary repairs will be implemented expeditiously to ensure adequate performance.
- 4. Using an **adaptive management** approach, particular practices may be modified in the field at the discretion of the project engineer, if consistent with the purpose of these ECPs.
- 5. If soil disturbance activities are temporarily ceased (21 days or more), or if heavy rain is anticipated during construction, **temporary measures** will be implemented such as temporary straw cover or erosion control blanket.
- 6. Final soil protection practices will be implemented **expeditiously**, usually within a day or two of final grading (but not exceeding 14 days after final grading). Prior to final practices, soil will be "fluffed" to promote moisture retention and plant success.

<u>BMPs</u> – The following is a presentation of **best management practices** that are routinely implemented at stream and wetland restoration projects for short- and long-term erosion protection. Additional BMPs may be implemented at the discretion of the project engineer.



Where practicable, bare vertical banks are **sloped and vegetated** to mitigate bank erosion. The target slope is generally 3:1 or less, unless a steeper slope is necessitated by site conditions. A **stone toe** may be placed at the base of the slope to provide short- and long-term protection against bank undermining. Alternative bank and toe protections include **rock vanes**, **root wads** and **coir logs**.



Disturbed soils below the ordinary high water mark (bankfull elevation) will be protected with durable, 100 percent biodegradable **erosion control blankets** (ECBs). High stress areas such as outside bends will be protected with five-year coir blanket (RoLanka BioD-Mat 90 or equivalent). The lower edge of coir ECB may be keyed into the soil ("**soil wrap**") to prevent washout. At the discretion of the project engineer, lower stress areas such as floodplains and inside bends may be protected with 12-month jute-reinforced straw blanket.



Disturbed soils above the bankfull elevation will be **covered** with straw to facilitate plant establishment and protect against raindrop impact erosion. Straw will be applied by hand-spreading or with a straw blower. At the discretion of the restoration ecologist, the straw may be tacked with netting or bonding agent if necessary due to wind or steep slopes.



Prior to placement of ECBs and straw, bare soil will be seeded with a season-appropriate **temporary cover crop** (e.g., annual wheat, rye, or oats at 3 pounds per 1000 sq ft) to provide short-term erosion protection. A site-appropriate mix of **native herbaceous, shrub, and tree seeds**, plus fertilizer if necessary, will also be seeded to provide long-term erosion protection. Light discing may be used before and/or after seeding at the discretion of the restoration ecologist.



Rock checks or constructed riffles are installed in incised channels to raise the channel elevation, provide roughness and stability, and to capture sediments. If practical, they are constructed from natural flagstone rather than blasted rock, and are keyed into the banks to prevent flanking. The maximum spacing is 5 channel widths for channel slopes less than 2 percent, decreasing to one channel width for 8 percent slopes. On channels greater than 2 percent, collected sediments may be left in-place to mimic natural step-pools.



Concentrated flow channels, for example from constructed wetlands, are stabilized using **rock-lined spillways**, underlain with non-woven filter fabric. Rock joints eventually silt-in and vegetation becomes established, further enhancing stability and ecological benefit.



Limited-traffic vehicle crossings on small tributaries will be stabilized by constructing **rock fords**, and may be underlain by non-woven filter fabric, in accordance with NRCS standards such as maximum 5:1 approach slopes.

APPENDIX D - RIPARIAN RESTORATION PLAN

PURPOSE – The purpose of this plan is to document procedures for the restoration and enhancement of native plant communities within the riparian buffer. The target native plant communities will exhibit a diversity of native wildflowers and grasses (meadows) and trees and shrubs (forest restoration) with high ecological value.

INVASIVE VEGETATION ERADICATION & CONTROL - Within the forested riparian buffer, the most common non-native invasive plants for targeted eradication include bush honeysuckle and multiflora rose. Within the non-forested riparian buffer, fescue and other cool-season grasses are the predominant invasive plants. Additional invasives will be controlled if during maintenance and monitoring they are found to threaten enhancement and restoration efforts.

The method of eradication and control is as follows: Physically remove, or cut and stump treat woody invasives such as bush honeysuckle with 20% glyphosate. Mow non-woody invasives such as fescue. Treat mowed non-woody vegetation and low growing woody vegetation with 2% glyphosate, one or more times as necessary to achieve control. Spot treat as necessary during the five-year maintenance and monitoring period.

CANDIDATE SPECIES FOR RE-FORESTATION (NOT ALL INCLUSIVE) - Candidate species of native plants short-listed for low organic, poor structure, clayey soil conditions are provided in Table 3. Species will be planted or seeded according to the site conditions (e.g., relative soil wetness, sun/shade, soil quality) and availability. No species will comprise more than 25 percent of the total planting.

Table 3 - Planting Palette

Common Name	Species	Indicator Status		
Tree				
red maple	Acer rubrum	FAC		
silver maple	Acer saccharinum	FACW		
hackberry	Celtis occidentalis	FACU		
redbud	Cercis canadensis	FACU-		
persimmon	Diospyros virginiana	FAC-		
spicebush	Lindera benzoin	FACW-		
sycamore	Platanus occidentalis	FACW-		
swamp white oak	Quercus bicolor	FACW+		
shingle oak	Quercus imbricaria	FAC		
bur oak	Quercus macrocarpa	FAC-		
pin oak	Quercus palustris	FACW		

Common Name	Species	Indicator Status	
Shumard oak	Quercus shumardii	FAC+	
Wildflowers			
New England aster	Aster novae-angliae	FAC	
partridge pea	Chamaecrista fasciculata	FACU	
boneset	Eupatorium perfoliatum	FACW+	
oxeye sunflower	Heliopsis helianthoides	UPL	
white snakeroot	Ageratina altissima	UPL	
gray-headed coneflower	Ratibida pinnata	UPL	
black-eyed Susan	Rudbeckia hirta	FACU-	
cut-leaf coneflower	Rudbeckia laciniata	FACW	
browneyed Susan	Rudbeckia triloba	FACU	
Grasses			
Virginia wildrye	Elymus virginicus	FACW-	
deertongue witchgrass	Panicum clandestinum	UPL	
little bluestem	Schizachyrium scoparium	FACU-	
indiangrass	Sorghastrum nutans	UPL	

PLANTING / SEEDING PLAN BY ZONE - Table 4 provides the planting plan by zone.

Table 4 - Planting Plan by Zone

Planting Zone	Plant Type	Plant Form	Planting Density	
5.5-Acre Bare Soil Area	Trees and Shrubs	1-gallon containers or bare root seedlings	800 plants/acre (except in managed meadows where trees will be planted in clumps at 40 plants/acre)	
Reforestation	Trees and Shrubs	Seeds	10 lbs/acre	
	Native Wildflowers	Seeds	10 lbs/acre	
	Native Grasses	Seeds	12 lbs/acre	
	Trees and Shrubs	1-gallon containers	40 plants/acre (as necessary)	
7-Acre Forest Enhancement	Native Wildflowers	Seeds	5 lbs/acre	
	Native Grasses	Seeds	12 lbs/acre	